

---

---

रासायनिक और विकिरण खतरों और  
खतरनाक रसायनों से संबन्धित पारिभाषिक  
शब्दावली

( पहला पुनरीक्षण )

**Glossary of Terms Relating to  
Chemical and Radiation Hazards and  
Hazardous Chemicals**

( First Revision )

ICS 71.100.01

©BIS 202H



भारतीय मानक ब्यूरो  
BUREAU OF INDIAN STANDARDS  
मानक भवन, 9 बहादुर शाह ज़फ़र मार्ग, नई दिल्ली - 110002  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI - 110002  
[www.bis.gov.in](http://www.bis.gov.in) [www.standardsbis.in](http://www.standardsbis.in)

January 2023

Price Group 17

## FOREWORD

‘This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards on recommendation of the Chemical Hazards Sectional Committee and approval of the Chemical Division Council’.

Realizing the rapid pace of industrialization within the country it was considered expedient to take up formulation of standards on definition and classification of chemical hazards; laboratory and industrial chemical hazards including air pollution. The concerned committee, while formulating standards on different aspects covered under its scope felt that formulation of a standard glossary of technical terms relating to chemical and radiation hazards and hazardous chemicals was necessary. Commonly used scientific terms may have a different import when specifically used in relation to different types of chemical hazards. That such a need for standardization of terminology for avoiding ambiguity and confusion in the use of the terms is vitally called for has been amply borne out through experience gained in the formulation of Indian Standards relating to laboratory, industrial and air pollution hazards.

This standard was originally published in 1966. Due to the changes in the respective fields such as Industry, Science and Technology that have happened, it has become necessary to review and update the existing glossary of terms. Consequently, this first revision has been prepared to keep all the definitions up to date with the latest definitions given in various publications such as International Standards, national regulations etc. as well as incorporating few additional terms and deleting some terms depending on their usage and meaning in the present context. In this revision amendment 1 and 2 have been also incorporated.

Should any difference exist between the definitions in this standard and those in the individual standards, the latter shall prevail. This standard is intended chiefly to cover the technical definitions of terms, and it may not necessarily include all the legal interpretations of terms.

This standard covers terms relating to chemical and radiation hazards and hazardous chemicals. Terms relating to air pollution have been covered separately. Terms relating to the principal chemical hazards, such as corrosive, explosive, flammable, oxidizing, poisonous and radioactive substances, have been include in this standard.

The composition of the committee responsible for the formulation of this standard is listed in Annex A.

# GLOSSARY OF TERMS RELATING TO CHEMICAL AND RADIATION HAZARDS AND HAZARDOUS CHEMICALS

( First Revision )

## 1 SCOPE

**1.1** This standard defines technical terms relating to chemical and radiation hazards and hazardous chemicals.

**1.2** It does not include terms relating to air pollution.

## 2 REFERENCES

The following standards contain provisions which through reference in this text constitute provisions of this standard. At the time of publications, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 14352 : 1996	Miner's Safety Goggles — Specification

## 3 TERMINOLOGY

### 3.1 Chemical hazards

#### A

**3.1.1 Abate** — To eliminate a hazard to comply with a regulatory standard that is being violated.

**3.1.2 Abatement** — Abatement is defined as an action by an employer to comply with a cited standard or regulation or to eliminate a recognized safety or health hazard identified by a regulatory board during an inspection. Examples of methods commonly used to abate cited hazards include the use of engineering controls, correction of deficiency in a program, or the use of permissible equipment to avoid a hazard.

**3.1.3 Abel Heat Test** — The principle of the test is to note the time required to produce a standard tint on a potassium iodide-starch paper when the explosive is heated under specified conditions.

**3.1.4 Abiotic** — This is a term used to describe anything which is characterized by the absence of life or incompatible with life. In toxicology and ecotoxicology it refers to physical (e.g. heat, sunlight) or chemical processes (e.g. hydrolysis) that are capable of modifying chemical structures.

**3.1.5 Abiotic Transformation** — Any process in which a chemical in the environment is modified by non-biological mechanisms.

**3.1.6 Absorbed Dose (in toxicology)** — The amount of a chemical absorbed into the body or into organs and tissues of interest.

**3.1.7 Absolute Application (Of CPQRA)** — The application of CPQRA in which the results of the analysis are compared against predetermined risk targets.

**3.1.8 Absorbing Medium** — A collection medium that allows for the penetration of airborne chemicals into the material where the chemicals will either physically dissolve or chemically react with the collection medium.

**3.1.9 Absorption** — As applied to chemical hazards, refers to the process of penetration of a position into the body. A material is said to be absorbed only when it has gained entry into the blood stream and consequently may be carried to all parts of the body. This requires that substances pass through the skin, mucous membrane or air sacs of the lungs.

As applied to radiation hazards, refers to processes by which radiation imparts some or all of its energy to any material through which it passes.

**3.1.10 Absorbed Dose** — The fundamental dosimetric quantity,  $D$  defined as  $D = dE/dm$ , where,  $dE$  is the mean energy imparted by ionizing radiation to matter in a volume element, and  $dm$  is the mass of matter in the volume element. The energy can be averaged over any defined volume, the average dose being equal to the total energy imparted in the volume divided by the mass in the volume. The SI unit of absorbed dose is joule per kilogram (J/Kg) termed as gray (Gy).

**3.1.11 Activity** — The quantity  $A$  for an amount of radionuclide in a given energy state at a given time is defined as:

$$A = (dN/dt)$$

where

$dN$  is the expectation value of the number of spontaneous nuclear transformations from the given energy state in a time interval  $dt$ . The SI unit of activity is the reciprocal of seconds ( $s^{-1}$ ), termed the Becquerel (Bq)

**3.1.12 Accelerating Rate Calorimetry (ARC)** — A technique in which a substance is heated in stages until very slow decomposition [or other reaction] is detected. The substance is then held under adiabatic conditions and the course of the decomposition or other reaction is monitored. (Also the name of a commercial test apparatus).

**3.1.13 Acceptable Air Quality** — Air in which there are no known contaminants at harmful levels as determined by occupational hygienists, and air with which 80 percent to 90 percent of the people do not express dissatisfaction based on comfort criteria: temperature, relative humidity, non-hazardous odors, and air movement.

**3.1.14 Acceptable Daily Intake (Pesticide Residues)** — The acceptable daily intake of a chemical is the daily intake which, during an entire life time, appears to be without appreciable risk to the health of the consumer on the basis of all the known facts at the time when a toxicological assessment is carried out. It is expressed in milligrams of the chemical per kilogram of body weight.

**3.1.15 Acceptable Risk** — Risk level deemed acceptable by an individual, organization, or society as a whole.

**3.1.16 Acceptance Sampling** — The procedures by which decisions to accept or reject a sampled lot or population are made based on the results of a sample inspection. In air pollution work, acceptance sampling could be used when checking a sample of filters for certain measurable characteristics such as pH, tensile strength, or collection efficiency to determine acceptance or rejection of a shipment of filters, or when checking the chemical content of a sample of vials of standard solutions from a lot of vials to be used in an inter-laboratory test.

**3.1.17 Acceptance Testing** — A systematic procedure to test as received materials before use to determine whether they are contaminated.

**3.1.18 Accident** — An unplanned event or sequence of events that results in undesirable consequences. An incident with specific safety consequences or impacts. The term accident is defined as any incident which is accompanied by actual negative consequences.

**3.1.19 Accident and Sickness Benefits (Non Occupational)** — Periodic payments to workers who are absent from work due to off-the-job disabilities through accident or sickness.

**3.1.20 Accidental Cause (Causal Factor)** — One or more factors associated with an incident or a potential incident. Causal factors may be identified as time-sequenced events or may be categorized as being related to human or environmental (e.g., equipment, machinery, atmospheric contaminant, temperature etc.) influences and their interactions.

**3.1.21 Accident Chain** — The term referring to the concept that many contributing factors typically lead to an incident, rather than one single event. Every incident as a result of a hazard is preventable by breaking the accident chain before the last link. Breaking the chain is known as intervention, which is reactive, whereas reducing the potential for an accident chain occurring is mitigation, which is proactive.

**3.1.22 Accident Costs** — Monetary losses associated with an incident. These costs include direct and indirect costs.

**3.1.23 Accidental Chemical Release** — An unintended, sudden release of chemical(s) from manufacturing, processing, handling or onsite storage facilities to the air, water, or land.

**3.1.24 Accident Experience** — One or more indices describing incident performance according to various units of measurement (e.g., disabling injury frequency rate, number of lost-time accidents, disabling injury severity-rate, number of first aid cases, or dollar loss). It may also refer to a summary statement describing incident performance.

**3.1.25 Accident-Free** — A record of no incidents, sometimes of specified types, relating to an operation, activity or worker performance during a specified time period.

**3.1.26 Accident Investigation** — A detailed, defined, and recorded review of an incident undertaken to identify and record the causes and contributing factors and their relationships, which led up to and caused the incident. Accident Investigation is a technique that allows an organization to learn from its experience. The intent of an incident investigation is for employers to learn from past experiences and thus avoid repeating past mistakes.

**3.1.27 Accident Location** — The exact position of the key event that produced an incident.

**3.1.28 Accident Potential** — A behavior(s) or condition(s) having a likelihood of producing an incident, which therefore require a review and improvement of hazard control measures.

**3.1.29 Accident Prevention** — The application of programs and counter measures, e.g., behaviors and conditions, designed to reduce incidents or incident potential within a system or organization.

**3.1.30 Accident Prevention Tag** — Tags used to identify hazardous conditions and provide a message to employees with respect to hazardous conditions. They contain a signal word, i.e., Danger, Caution, Warning and indicate the specific hazardous condition or the instruction to be communicated to the employee such as —High Voltage, —Close Clearance, —Do Not Start, or —Do Not Use, or a corresponding

pictograph used with written text or alone. They are used as a means to prevent injury or illness to employees who are exposed to hazardous or potentially hazardous conditions, equipment, or operations that are out of the ordinary, unexpected, or not readily apparent. The tags are to be used until the identified hazard is eliminated or the hazardous operation is completed.

**3.1.31 Accident Probability** — The likelihood of a worker, operation, or item of equipment becoming involved in an incident. The probability of a set of unsafe conditions and/or unsafe acts producing an incident.

**3.1.32 Accident Rate** — Incident experience in relation to a base unit of measure (e.g., number of disabling injuries per 1 000 000 employee/h exposure, number of incidents per 1 000 000 miles traveled, total number of incidents per 1 00 000 employee-days worked, number of incidents per 100 employees, etc.).

**3.1.33 Accident Records** — Reports and other recorded information concerning employee incident experience.

**3.1.34 Accident Report** — A document containing the information and facts about an individual incident put in chronological order to provide a complete picture as to what happened. The report is useful for the investigation to help establish the root cause of the incident.

**3.1.35 Accident Reporting** — Collecting information for, and/or preparing and submitting to a designated individual or agency, an official report of an incident.

**3.1.36 Accident Severity** — The extent of a loss caused by an incident. It is used by insurers in predicting the number of losses upon which the insurance premium is based.

**3.1.37 Accident Site** — The location of an unexpected occurrence, failure, or loss, either at a plant or along a transportation route, resulting in a release of hazardous materials.

**3.1.38 Accident Statistics** — Descriptive or inferential data that provide information about incident occurrences.

**3.1.39 Accident Triangle** — A statistical ratio of incidents, which highlights the frequency and severity. The relationship is depicted in a graphical form of a triangle, sometimes depicted as a loss pyramid, with frequencies on one side and severities on the adjacent side.

**3.1.40 Accident Type** — A description of the occurrences directly related to the source of injury classification and explaining how that source produced the injury. Accident type answers the question: How did the injured person come in contact with the object, substance, or exposure named as the source of injury,

or during what personal movement did the bodily injury occur?

**3.1.41 Accidental Death and Dismemberment** — A term used to describe an insurance policy that pays additional benefits to the beneficiary if the cause of death is due to a non-work-related incident. Fractional amounts of the policy will be paid out if the covered employee loses a bodily appendage or sight because of an incident.

**3.1.42 Action Error Analysis (AEA)** — A type of safety identification review that methodically analyzes the interactions between individuals and machines. It reviews the operation phase to operational phase, while considering the consequences of operator-system faults at each operating step within each phase. This analysis allows for the recognition of threats from equipment faults that may coexist with operator errors. It is considered similar to a Failure Mode and Effects Analysis (FMEA), but with increased emphasis on the steps in human procedures rather than viewing hardware exclusively. *See also* Failure Mode and Effects Analysis (FMEA); Job Safety Analysis (JSA).

**3.1.43 Action Level** — Terminology to state the level of toxicant that requires medical surveillance and training to further protect employees. It is usually one-half the level of the permissible exposure limit. Action levels exist for only a few air contaminants, such as lead, cadmium, and benzene.

**3.1.44 Accumulation** — The pressure increase over the maximum allowable working pressure of a vessel during discharge through the pressure relief device, expressed in pressure units or as a percent. Maximum allowable accumulations are established by applicable codes for operating and fire contingencies.

**3.1.45 Acid Rain** — The deposition of acids (sulphuric and nitric) in rain. An environmental problem resulting from certain industrial activities and the burning of petroleum based fuels (traffic exhaust gases).

**3.1.46 Activity Sampling** — A measurement technique for evaluating potential incident-producing behavior. It involves the observation of worker and organizational behavior at random intervals and the instantaneous classification of these behaviors according to whether they are safe or unsafe.

**3.1.47 Actual Exposure Hours** — Employee-hours of exposure to workplace hazards taken from payroll or time clock records, wherever possible, and including only actual straight time worked (in hours) and actual overtime hours worked.

**3.1.48 Activated Carbon (Charcoal)** — Used to adsorb components of gas mixtures or impurities from liquids as they permeate across its surface.

**3.1.49 Activation Energy** — The constant E in the exponential part of the Arrhenius equation,

associated with the minimum energy difference between the reactants and an activated complex (transition state), which has a structure intermediate to those of the reactants and the products, or with the minimum collision energy between molecules that is required to enable a reaction to occur. It is a constant that defines the effect of temperature on reaction rate.

**3.1.50 Acute** — Having a rapid onset and progression.

**3.1.51 Action Level** — The level of dose rate or activity concentration above which remedial actions or protective actions should be carried out in chronic exposure or emergency exposure.

**3.1.52 Acuity** — The sharpness of a sense. Pertaining to the sensitivity of hearing, vision, smell, or touch.

**3.1.53 Acute Effects** — Effects that occur rapidly following exposure and are of short duration.

**3.1.54 Acute Hazard** — A single exposure that may cause harm, but which is unlikely to lead to permanent damage.

**3.1.55 Acute Risk** — A risk associated with immediate effects of episodic events such as fire, explosion, and toxic material releases.

**3.1.56 Additive Effect** — An additive effect is the overall consequence which is the result of two chemicals acting together and which is the simple sum of the effects of the chemicals acting independently. See also antagonistic effect, synergistic effect.

**3.1.57 Adiabatic Lapse Rate (ALR)** — *see* Dry adiabatic lapse rate.

**3.1.58 Administrative Controls** — Methods of controlling employee exposures. These controls include administrative procedures, location and proximity, time periods away from the hazard, training in work practices to avoid the hazard, work assignments, etc.

**3.1.59 Aerosol** — A colloidal system in which the dispersion medium is a gas.

**3.1.60 Aerosol Fraction** — The fraction of liquid phase which, when flushed to the atmosphere, remains suspended as an aerosol.

**3.1.61 Alarm** — A signal indicating an emergency requiring an immediate action, such as an alarm for fire from a manual fire alarm box, a fire sprinkler system water flow alarm, toxic or combustible gas detection, or an alarm from an automatic detection system. Alarms can be visual (flashing or strobe light/beacon), audible (bells, horns, buzzers, etc.), or both.

**3.1.62 Alarm Condition** — A predefined change in the state or condition of equipment, or the failure of the equipment to respond correctly. Such an indication may be audible or visual or both.

**3.1.63 Aliphatic** — Usually applied to petroleum products derived from a paraffin base and having a straight or branched chain, or saturated or unsaturated molecular structure.

**3.1.64 Alkali** — A compound that has the ability to neutralize an acid and form a salt. Turns litmus paper blue and has pH values of 8 to 14. (Also known as base, caustic).

**3.1.65 Alumina-Activated-Sieve** — Adsorbent in pellet form used to purify gases and liquids.

**3.1.66 Alcohol Foam** — A type of foam developed to suppress ignitable vapors on polar solvents (those miscible in water). Examples of polar flammable liquids are alcohols and ketones.

**3.1.67 Allergen** — This descriptor may be used to any substance which produces an allergic reaction.

**3.1.68 All Risks Insurance** — Insurance provided against loss of or damage to property arising from any fortuitous cause except those that are specifically excluded in the insurance contract. An All Risk Insurance is termed to be an All Risks policy.

**3.1.69 Amelioration** — Improvement of conditions immediately after an accident; treatment of injuries and conditions which endanger people and property.

**3.1.70 Ampoule** — A small sealed glass vial filled with liquid.

**3.1.71 Ampoule Detector Tube** — A detector tube consisting of one or more filling layers and a reagent ampoule. The ampoule contains part of the reagent system, which for reasons of stability cannot be placed in a single tube. During use, the ampoule is broken and the contents liberated.

**3.1.72 Analogue** — Compound of the same structural type.

**3.1.73 Analytical Blank** — A blank used as a baseline for the analytical portion of a method. For example, a blank consisting of a sample from a batch of absorbing solution used for normal samples but processed through the analytical system only, and used to adjust or correct routine analytical results. (Also known as reagent blank)

**3.1.74 Analytical Methods** — Detailed laboratory procedures that specify how to measure the amount of chemicals collected on the sampling media.

**3.1.75 Antagonistic Effect** — This is the consequence of one chemical (or a group of chemicals) interacting: the situation in which the combined effect of two or more chemicals is less than the simple sum of their independent effects. In bioassay, the term may be used to refer to the situation when a specified response is produced by exposure to either of two factors but not by exposure to both together.

**3.1.76 Antidote** — A material administered to an individual who has been exposed to a poison in order to counteract its toxic effects.

**3.1.77 Antiparticle** — A particle with the same mass and spin with opposite charge and magnetic field.

**3.1.78 Antistatic Wrist Strap** — An antistatic device worn by an individual on the wrist to prevent the accumulation and discharge of static electricity to static-sensitive electronic equipment by safely grounding the individual.

**3.1.79 Arc** — A luminous, high-intensity electrical discharge in a gas or a vapor. It occurs when the voltage in a conductor is great enough to create a path between itself and another conductor that is at a lower voltage. The arc created is capable of crossing or jumping the air gap in insulation that separates the two conductors. Arcing may be a source of ignition for a fire if it is of sufficient energy. It also generates ultraviolet radiation, which can burn the retina of the eye along with the skin. It may also be called spark discharge. *see also* Arc Blast; Arc Flash; Spark.

**3.1.80 Arc Blast** — Arc Blast is a result of the arc flash, and its force is dependent on the amount of short-circuit current available and the distance from the arc source. When copper super heats, as is the case when an arc flash occurs, the copper can expand up to 67 000 times. This expansion causes molten copper to be spewed away from the source in a very forceful manner. This force or pressure can cause injury to body parts, or the body can be injured from a resultant fall or from being thrown into a nearby object.

**3.1.81 Arc Flash** — A fire flash, or arc, that can be produced during an electrical failure or fault. It can reach temperatures of 19 982 °C (36 000 °F). The temperature of the arc is a function of short-circuit current availability and distance from the arc source.

**3.1.82 Arc Flash Hazard Analysis** — A review of the potential exposure of an individual to arc flash energy to prevent its occurrence or injury to personnel and determine appropriate safe work practices, arc flash protection boundary, and the necessary levels of personal protective equipment.

**3.1.83 Arc Flash Protection Boundary** — The approach limit at a distance from a prospective arc source or arc flash hazard within which an individual could receive a second-degree burn if an electrical arc flash incident occurs.

**3.1.84 Arc Flash Suit** — Flame-resistant clothing and equipment that encapsulates the entire body, except for the hands and feet. It includes pants, jacket, and hood with a face shield.

**3.1.85 Arc Resistant Switchgear** — Equipment that is designed to withstand an internal arcing fault and directs the internally released energy away from an individual.

**3.1.86 Area Hazard Analysis (AHA)** — A process for analyzing hazards, focused on the hazards an individual faces in their work area as opposed to hazards of individual work activities.

**3.1.87 Area Sampling** — The collection of airborne chemicals at a fixed position in the work area.

**3.1.88 Arson** — The burning of buildings or property with malicious or criminal design, generally utilizing highly flammable materials or explosives to spread the fire quickly, or deliberately placed obstructions to impede fire fighting. This action may be performed by the owner or others and is by law a crime subject to federal jurisdiction.

**3.1.89 Asphyxia** — Suffocation from lack of oxygen. Chemical asphyxia is produced by a substance, such as carbon monoxide, that combines with hemoglobin to reduce the blood's capacity to transport oxygen. Simple asphyxia is the result of exposure to a substance, such as carbon dioxide, that displaces oxygen.

### **3.1.90 Asphyxiant**

**3.1.90.1** A vapor or gas that can cause unconsciousness or death by suffocation (lack of oxygen). Most of the simple asphyxiants are harmful to the body only when they become so concentrated that they reduce oxygen in the air (normally about 21 percent) to dangerous levels (18 percent or lower). Asphyxiant is one of the principal potential hazards of working in confined and enclosed spaces.

**3.1.90.2** A chemical that displaces oxygen in air, potentially resulting in insufficient oxygen to sustain life, especially in poorly ventilated areas. A chemical Asphyxiant chemically interferes with the body's ability to take up and transport oxygen; a physical Asphyxiant displaces oxygen in the environment.

**3.1.91 Assay** — The quantitative or qualitative evaluation of a hazardous substance; the results of such an evaluation.

**3.1.92 Assigned Risk** — Many states have unsatisfied judgment or financial responsibility laws that make the purchase of insurance mandatory. Some motorists cannot buy insurance for some reason, such as poor accident experience. To make it possible for them to be insured, there are assigned risk plans in which such risks are insured. These risks are rotated among the subscribing companies in proportion to the amount of automobile liability insurance each writes in the state. All companies writing this class of insurance are required to participate in this activity. A comparable system operates in some states with respect to worker's compensation.

**3.1.93 Assumption of Risk** — The legal theory that a person who is aware of a danger and its extent and knowingly exposes him- or herself to it assumes all risks and cannot recover damages, even though the person is injured through no fault of his or her own.

**3.1.94 Atmospheric Dispersion** — The low momentum mixing of a gas or vapor with air. The mixing is the result of turbulent energy exchange, which is a function of wind (mechanical eddy formation) and atmospheric temperature profile (thermal eddy formation).

**3.1.95 Atmospheric Stability** — Measure of the degree of atmospheric turbulence and resulting gas dispersion. The stability classes are defined in terms of the wind speed and thermal input from the sun.

**3.1.96 Audit, Safety** — A management tool used to measure the effectiveness and efficiency of the implementation of safety policy, programs, and procedures by subjecting each area of an activity to a systematic critical examination with the purposes of minimizing loss and providing a quantified assessment of performance and actions needed to render identified hazards harmless.

**3.1.97 Autocatalysis** — The increase of the rate of reaction due to the catalyzing effect of the reaction products.

**3.1.98 Auto Decomposition** — The sustained decomposition of a substance without introduction of any other apparent ignition sources besides thermal energy and without air or other oxidant present. Auto decomposition is a result of a thermal self-decomposition reaction for given initial conditions (temperature, pressure, volume) at which the rate of heat evolution exceeds the rate of heat loss from the reacting system thus resulting in an increasing reaction temperature and reaction rate.

**3.1.99 Auto Decomposition Temperature** — The minimum temperature for a specified test method, test apparatus (including material of construction and test volume) and initial pressure required to initiate self-sustained decomposition of a solid, liquid or gaseous

substance without any other apparent source of ignition and without air or other oxidant present.

**3.1.100 Auto Ignition** — The ignition and sustained combustion of a substance without introduction of any other apparent ignition source besides thermal energy. Auto ignition is a result of oxidation for given initial conditions, (temperature, pressure, volume) at which the rate of heat gain exceeds the rate of heat loss from the reacting system thus resulting in an increasing reaction temperature and reaction rate.

**3.1.101 Auto Oxidation** — Slow reaction with air.

**3.1.102 Automatic Fire Alarm System** — A system of controls, initiating devices, and alarm signals in which all or some of the initiating circuits are activated by automatic devices, such as smoke detectors.

**3.1.103 Automatic Guard** — A protective device (e.g. barrier) that is associated with and dependent upon the mechanism of the machinery. It operates to physically remove from the danger area any part of an individual exposed to harm.

**3.1.104 Automatic Safe Load Indicator** — A device fitted to a crane to provide the operator with automatic warning of approach to an overload situation.

**3.1.105 Automatic Seat Belt System** — A protective system fitted to a vehicle that automatically moves the seat belt restraint system from its storage location to its protection location, i.e., over the shoulder of an individual, to ensure that the seat belt is worn and assist in protecting the individual from injury if a crash occurs. Upon leaving the vehicle the belt automatically moves to its storage position.

**3.1.106 Average Individual Risk**

**3.1.106.1 Average individual risk (exposed population)** — The individual risk averaged over the population which is exposed to risk from the facility.

**3.1.106.2 Average individual risk (total population)** — The individual risk averaged over a predetermined population, without regard to whether or not all people in that population are actually exposed to the risk.

**3.1.106.3 Average individual risk (exposed hours/working hours)** — The individual risk for an activity may be calculated for the duration of the activity or may be averaged over the working day.

**3.1.107 Average Rate of Death (ROD)** — The average number of fatalities that might be expected per unit time from all possible incidents.



**3.1.108 Avoidable Accident** — An incident that could have been prevented by proper behavior, or by environmental modifications or controls. All incidents are considered preventable.

**3.1.109 Awareness Level Trained** — First responders at the awareness level are those persons who, in the course of their normal duties may be the first on the scene of an emergency involving hazardous materials. First responders at the awareness level are expected to recognize hazardous materials presence, protect themselves, call for trained personnel, and secure the area.

## B

**3.1.110 Backup Alarm** — An automatic audible sounding alarm fitted to designated vehicles to warn whenever the vehicle is engaged to move in the reverse direction. It is commonly used on construction sites for equipment or other similar locations, where workers may not be cognizant of the various operations of vehicles in their environment, other equipment masks the normal sound of the vehicle approaching in reverse, or their hearing level may not be the norm.

**3.1.111 Backup Layer** — The secondary layer of sorbent material in a sorbent tube that adsorbs chemicals that are not effectively trapped onto the primary collection layer.

**3.1.112 Balanced Safety Relief Valve** — A balanced safety relief valve incorporates means of minimizing the effect of back pressure on the operational characteristics (opening pressure, closing pressure, and relieving capacity).

**3.1.113 Barometric Hazard** — From the occupational hygiene perspective, barometric hazards can be categorized as: 1) hypobaric (low pressure) hazards; 2) hyperbaric (high pressure) hazards; and 3) hazards from changes in pressure, predominantly-but not exclusively-decreases in pressure.

**3.1.114 Barricade (Armoured Hood)** — Protective hood that will shield the operator against flames or explosive particles.

**3.1.115 Barrier Analysis** — An investigative safety review based on the premise that an energy flow is associated with all incidents. Barriers are developed and integrated into a system or work process to protect personnel and equipment from unwanted energy flows. For an incident to occur there must be a hazard that comes into contact with a target, because barriers or controls were unused or failed. It may be called a barrier and control analysis or energy trace and barrier analysis. Barriers can be Physical (guarding, shields, protective clothing), Administrative (engineering design, work procedures, work processes), or Supervisory/Management (training, knowledge, supervision, management oversight).

**3.1.116 Barrier Guard** — A protection device for operators and other individuals from hazard points on machinery and equipment. There are several types of barrier guards: adjustable, fixed, movable, and interlocking. Adjustable barrier guards have an enclosure attached to the frame of the machinery or equipment, with front and side sections that can be adjusted. Fixed barrier guards are a point of operation enclosure attached to the machine or equipment. The gate or movable barrier guard is a device designed to enclose the point of operation completely before the clutch can be engaged. An interlocking guard is connected to a switch so that the operation of the machine or equipment cannot be started unless the guard is in place. It may also stop the machine or equipment if the guard is moved while it is in operation.

**3.1.117 Barrier Tape** — A temporary delineation measure used to quickly and effectively highlight restricted areas, particularly for hazard avoidance or emergencies. It is composed of a high visibility polyethylene plastic tape that is used to surround or section-off hazard areas, danger zones, and construction sites. Barrier tapes typically have a clear, bold warning message that is continuously repeated the length of the roll. They provide a visual warning message to keep out of restricted areas. It is also ideal for crowd and traffic control purposes. Commercially available tape rolls are 7.6 cm (3 inch) wide and are 2 540 cm (1 000 inch) in length. It also can be called Perimeter Tape or Safety Tape.

**3.1.118 Basic Event** — A fault tree event that is sufficiently basic that no further development is necessary (e.g., equipment item failure, human failure, or external event). *See also Undeveloped event.*

**3.1.119 Basic Process Control Equipment (BPCS)** — The control equipment which is installed to support normal production functions.

**3.1.120 Batch Method** — A static generation method for preparing a known mixture of gas or vapor for verification testing of detector tubes. The method uses a volatile liquid to produce a known concentration in a container of known volume. A pure gas, or vapor of known volume and concentration, could be used also.

**3.1.121 Batch Reactor** — Reactor in which all reactants and solvents are introduced prior to setting the operating conditions (e.g., temperature and pressure).

**3.1.122 Bentonite Clay** — Highly adsorbent Fuller's earth clay used in particle form for containing chemical spills (available to the public as cat litter).

**3.1.123 Biochemical Mechanism** — This is the general term for any chemical reaction or series of reactions, usually enzyme catalyzed, which produces a given physiological effect in a living organism.

**3.1.124 Bio-concentration** — A process leading to a higher concentration of a chemical in the organism relative to its environment.

**3.1.125 Biodegradation-Biodegraded** — Breakdown of chemicals, plastics, polymers etc., by the reaction of light, heat, water, bacteria, fungi, each on its own or in concert.

**3.1.126 Biotransformation** — A process in which a chemical is modified by a living organism.

**3.1.127 BOD (Biochemical Oxygen Demand)** — This is defined as the mass of dissolved oxygen required by a specific volume of solution of the substance for process of biochemical oxidation under prescribed conditions. The measurement of BOD indicates the ability of micro-organisms to metabolize an organic substance in the presence of oxygen and thus indicates the potential for depletion of oxygen by the substance. Refers to degradation.

**3.1.128 Blast** — A transient change in gas density, pressure (both positive and negative), and velocity of the air surrounding an explosive point. The most common sources of blasts are from the ignition of semi- or unconfined vapor cloud explosions, detonation of high explosives, or the rupture of high-pressure vessels. The initial change can be either gradual or discontinuous. A discontinuous change is commonly referred to as a shockwave, and a gradual change as a pressure wave.

**3.1.129 BLEVE** — *see* Boiling Liquid Expanding Vapor Explosion

**3.1.130 Blow Down** — The difference between actual popping pressure of a pressure relief valve and actual reseating pressure expressed as a percentage of set pressure or in pressure units.

**3.1.131 Blowout** — An uncontrolled flow of gas or oil, and combination of these or other well fluids from a wellbore at the well head or into the petroleum formation during a drilling operation. It is caused by formation pressure exceeding the drilling fluid pressure.

**3.1.132 Blowout Preventer (BOP)** — A mechanism to rapidly close and seal off a well borehole, which is used to prevent a well blowout from occurring. It consists of rams and shear rams, usually hydraulically operated, which are fitted at the top of the well being drilled. It is activated if well pressures are encountered that cannot be controlled by the drilling process systems (i.e., drilling mud injection) and could lead to a blowout of the well.

**3.1.133 Blood Asphyxiant** — A chemical that is absorbed by the blood and changes or prevents the blood from flowing or carrying oxygen to cells. An example is carbon monoxide poisoning.

**3.1.134 Boil** — To change from a liquid state to a gaseous state.

**3.1.135 Boilover** — A boiling liquid eruption in a hydrocarbon or chemical storage tank. Usually described as an event in the burning of the contents of the tank, where after a long period of time, there is a sudden increase in fire intensity with the expulsion of the contents of the tank, due to water at the bottom of the tank being heated to vaporization and causing a boiling eruption.

**3.1.136 Boiling Liquid Expanding Vapor Explosion (BLEVE)** — A type of rapid phase transition in which a liquid contained above its atmospheric boiling point is rapidly depressurized, causing a nearly instantaneous transition from liquid to vapor with a corresponding energy release. A BLEVE is often accompanied by a large fireball if a flammable liquid is involved, since an external fire impinging on the vapor space of a pressure vessel is a common BLEVE scenario. However, it is not necessary for the liquid to be flammable to have a BLEVE occur.

**3.1.137 Bonding** — The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to safely conduct any current likely to be imposed.

**3.1.138 Bounding Group (of Incidents)** — A small number of incidents selected to bracket the spectrum of possible incidents, which may include those catastrophic incidents sometimes, referred to as the Worst Credible Incident and Worst Possible Incident.

**3.1.139 Breakthrough time** — The time taken in standard tests for permeation of a chemical through a protective barrier (such as a rubber glove) to be detected.

**3.1.140 Bunsen Tube** — A pressure release device.

## C

**3.1.141 Calibrate** — To check, adjust, or systematically standardize the graduations of a quantitative measuring instrument.

**3.1.142 Calibration** — Establishment of a relationship between various calibration standards and the measurements of them obtained by a measurement system, or portions thereof. The levels of the calibration standards should bracket the range of levels for which actual measurements are to be made.

**3.1.143 Calibration Standard** — A standard used to quantitate the relationship between the output of a sensor and a property to be measured. Calibration standards should be traceable to a standard reference material (SRM), certified reference material (CRM), or a primary standard.

**3.1.144 Calorie** — Heat required to raise the temperature of 1 gram of water 1 °C, specifically from 4 °C to 5 °C. Mean calorie = 1/100 part of the heat required to raise 1 gram of water from 0 °C to 100 °C. Great calorie or kilocalorie = 1 000 calories.

### **3.1.145 Calorimeter**

**3.1.145.1** A device for measuring heat quantities, such as machine capacity, combustion heat, specific heat, vital heat, heat leakage, etc.

**3.1.145.2** A device for measuring quality (or moisture content) of steam or other vapor.

**3.1.145.3** Equipment for measuring emitted or absorbed heat quantities

**3.1.146 Canister (Air-Purifying)** — A container filled with sorbents and catalysts that remove gases and vapors from air drawn through the unit. The canister may also contain an aerosol (particulate) filter to remove solid or liquid particles.

**3.1.147 Canister Respirator** — A form of gas respirator, which generally incorporates goggles and a visor, with an exhalation valve connected to a chemical canister filter. It normally provides protection against low concentrations of designated toxic gases and vapors.

**3.1.148 Carabiner** — A self-closing, self-locking steel connector used to attach to an anchorage point. Used with a personal fall protection system.

**3.1.149 Cap** — That part of a cartridge or shell which is filled with a detonative composition and is fired by a percussion strike. It ignites the propellant charge in gun and small arm ammunition.

**3.1.150 Carbon dioxide Toxicity** — Carbon dioxide becomes toxic when it suppresses respiration. The combination of the accumulation of exhaled carbon dioxide at increased pressure (either in the breathing system's dead space or due to a malfunction) can rapidly cause toxic effects.

**3.1.151 Carcinogen** — An agent, chemical, physical or biological, that can act on living tissue in such a way as to cause a malignant neoplasm.

**3.1.152 Carcinogenesis** — The induction by chemical, physical, or biological agents, of neoplasms that are usually not observed, an earlier induction of neoplasms that are usually observed, and/or the induction of more neoplasms than are usually found although fundamental differences in the mechanisms may be involved.

**3.1.153 Catalyst** — A process developed by the Electric Power Research Institute for conducting payoff matrix analyses with a group of participants.

**3.1.154 Catastrophic** — A loss of extraordinary magnitude in physical harm to people, with damage and destruction to property, and/or to the environment.

**3.1.155 Catastrophic Incident** — An incident involving a major uncontrolled emission, fire or explosion with an outcome effect zone that might extend offsite into the surrounding community.

**3.1.156 Catch Pot** — A container to retain liquid or slurry discharged from an overflow or pressure-relief device.

**3.1.157 Cartridge, Air Purifying** — A container with a filter, sorbent, or catalyst, or combination of these items, that removes specific contaminants from the air passed through the container.

**3.1.158 Cartridge Respirator** — A respirator that has a chemical cartridge filter and is effective for low concentrations of relatively non-toxic gases or vapors.

**3.1.159 Causal Factor (CF)** — The immediate major contributor to the occurrence of an incident. A combination of simultaneous or sequential circumstances directly or indirectly contributing to an incident that if they were removed would have either prevented the incident or reduced its consequences. For a typical incident event there are multiple causal factors. Causal factors were formerly called direct causes, key causes, observable causes, and assignable causes. Can be modified to identify several kinds of causes such as direct, early, mediate, proximate, distal, etc.

**3.1.160 Cause** — An event, situation, or condition which results, or could result (Potential Cause), directly or indirectly in an accident or incident.

**3.1.161 Cause Consequence Diagrams** — A method for illustrating the possible outcomes arising from the logical combination of selected input events or states.

**3.1.162 Caustic** — Something alkaline that strongly irritates, corrodes, or destroys living tissue.

**3.1.163 Charles-Gay-Lussac-Law** — Gases increase in volume for each 1 °C rise in temperature. This increase is equal to approximately 1/273.15 of the volume of the gas at 0 °C.

**3.1.164 Chatter** — Chatter is abnormal rapid reciprocating motion of the movable parts of a pressure relief valve in which the disk contacts the seat.

**3.1.165 Chemo-biokinetics** — The process of the uptake of chemical substances by the body, the biotransformation they undergo, the distribution of the substances and their metabolites in the tissues, and the elimination of the substances and their metabolites from the body. Both the amounts and the concentrations of the substances and their metabolites are studied. The term has essentially the same meaning as pharmacokinetics.

kinetics, but the latter term should be restricted to the study of pharmaceutical substances.

**3.1.166 Chemical** — Any element, chemical compound or mixture of elements and/or compounds.

**3.1.167 Chemical Agent** — Dust, gas vapor, or fume that acts on or reacts with the human physiologic system.

**3.1.168 Chemical Allergy** — Allergy caused by a specific chemical or group of chemicals.

**3.1.169 Chemical Asphyxiant** — *see* asphyxiant (2.89)

**3.1.170 Chemical Asphyxiation** — Toxic reaction wherein chemicals reaching the bloodstream react in such a way as to deprive the body of oxygen.

**3.1.171 Chemical Burn** — A burn that occurs when the skin comes into contact with strong acids, strong alkalis or other corrosive materials. These agents literally eat through the skin and in many cases continue to do damage as long as they remain in contact with the skin.

**3.1.172 Chemical Cartridge** — A filtering mechanism used with a respirator for the removal of low concentrations of specific vapors and gases. It is constructed mechanically as a cartridge for ease of replacement after use or expiry date.

**3.1.173 Chemical Cartridge Respirator** — A respirator that uses various chemical substances to purify the inhaled air of certain vapors and gases.

**3.1.174 Chemically Contaminated Biological Waste** — Biological waste that contains pollutant or toxic chemicals.

**3.1.175 Chemical Decontamination** — The process of removing residual amounts of harmful chemicals from glassware or other equipment so as to facilitate their safe use or repair. The process should be based on the knowledge of the properties of the contaminant(s), so as to effectively remove or destroy such substances by appropriate chemical or physical treatment.

**3.1.176 Chemical Family** — A group of single elements or compounds with a common general name.

**3.1.177 Chemical Hazard** — Exposure to any chemical which, in acute concentrations, has a toxic effect.

**3.1.178 Chemical Incompatibility** — Any interaction of a chemical and an environmental factor (e.g., water, light, air), or between two or more chemicals, that may give rise to a chemical reaction or produce an enhanced hazard.

**3.1.179 Chemical Name** — The name given to a chemical in the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the CAS. The scientific designation of a chemical or a name that will clearly identify the chemical for hazard evaluation process.

**3.1.180 Chemical Pneumonitis** — Inflammation of the lungs resulting from inhalation of chemical vapors and characterized by an outpouring of fluid in the lungs.

**3.1.181 Chemical Spills Prevention** — A planned way of dealing with or preventing chemical spills. e.g., a systematic method for the containment of the chemicals that includes small volumes of stock containers, closures that facilitate safe transfer of materials, break resistant containers, or working over trays lined with absorbent material.

**3.1.182 Chemical Waste** — Chemical waste is either organic (hydrocarbons or substituted hydrocarbons) or inorganic (metallic or nonmetallic elements). The hydrocarbons are composed solely of carbon and hydrogen; substituted hydrocarbons also include functional groups composed of elements such as chlorine, nitrogen, phosphorus, sulphur or oxygen. Inorganic waste materials are typically in the form of salts, hydrides and oxides. The hazards associated with organic compounds in the environment depend mainly on their chemical compositions and associated physical properties.

**3.1.183 Chemicals of Potential Concern (CoPC)** — Chemicals that are potential site-related and whose data are of sufficient quality for use in the quantitative risk assessment.

**3.1.184 Chemical Properties** — A property of matter that describes how it reacts with other substances.

**3.1.185 Chemical Protective Clothing** — Items such as clothing, hood, boots and gloves (fully-encapsulating suit) made from chemical-resistant materials that are designed and configured to protect the wearer from hazardous materials.

**3.1.186 Chemical Reactivity** — The tendency of substances to undergo chemical change.

**3.1.187 Chemical Reactivity Hazard** — A situation with the potential for an uncontrolled chemical reaction that can result directly or indirectly in serious harm to people, property or the environment. The uncontrolled

chemical reaction might be accompanied by a temperature increase, pressure increase, gas evolution or other form of energy release.

**3.1.188 COD (Chemical Oxygen Demand)** — The amount of oxygen required to oxidize the substance chemically. Refers to degradation.

**3.1.189 Choked Flow** — A condition that occurs when the flow of a compressible fluid through a pressure relief device, piping or other equipment does not respond to a decrease in downstream or back pressure on the device. The mass flow rate then depends only on upstream conditions. This can occur with gas/vapor or with two-phase fluid systems. Also referred as maximum or critical flow.

**3.1.190 Chronic Effects** — Effects that develop slowly and have a long duration. They are often, but not always, irreversible. Some irreversible effects may appear a long time after the chemical substance was present in the sensitive tissue. For such delayed or late effects, the latent period (or the “time to occurrence” of an observable effect) may be very long, particularly if the level of exposure is low.

**3.1.191 Chronic Exposure** — Repeated dose or exposure to a material over a relatively prolonged period of time.

**3.1.192 Chronic Hazard** — Chemical which has the potential to cause long-term damage to health, often as a consequence of repeated or prolonged exposure to it.

**3.1.193 Chronically Toxic Substance** — A chemical that causes damage after exposure of repeated or long-duration, usually in low concentration.

**3.1.194 Chrysiasis** — Development of a blue-gray pigmentation in skin and mucous membranes. May be caused by exposure to gold compounds.

**3.1.195 Circuit Breaker** — A safety device for electrical circuits designed to open the circuit, i.e., from on to off position, when abnormal conditions occur (i.e., over current, abnormal voltage, high temperature, grounding, etc.) to prevent damage or overheating to the system and the possible occurrence of a fire. They are usually designed to permit opening and closing of the circuits manually but will automatically open the circuit during the occurrence of an abnormal condition. Circuit breakers should be of the type and rating for the circuit or appliance it is intended to protect.

**3.1.196 Circumstances (of an Accident)** — The set of conditions that surround an incident or led to it.

**3.1.197 Cis** — refers to a particular arrangement of elements with a chemical molecule.

**3.1.198 Cleveland Open Cap Method** — A method for determining the flash point of a liquid. In this the vapour being experimented upon has free access to air and thus is slightly less concentrated than the one in the

Closed Cup Method (*see also* ‘Closed Cup Method’).

**3.1.199 Clean-Up Reporting** — Action taken following a spillage or contamination which documents containment, disposal and decontamination procedures, together with suggestions to prevent similar accidents.

**3.1.200 Closed Cup Method** — One of the methods for determining the flash point of a liquid. In this method, measurements are made on a saturated vapour air mixture obtained in a closed cup.

**3.1.201 Code of Safe Practices** — Workplace rules on how to perform duties safely and keep the worksite safe; must be specific to the employer’s operations and posted at each job site.

**3.1.202 Cold Work** — Work activities that do not produce sufficient energy to ignite flammable atmospheres or combustible materials, but could contribute to an incident where an injury may occur. Common examples of cold work activities include demolition; removal of asbestos-containing materials; work involving cryogenic materials; movement of oversized loads on roads; maintenance work at steam, sewage, utility plants not involving open flames; seal or gland replacement; and repairs on pumps or compressors.

**3.1.203 Cold Work Permit** — A safety process control for cold work activity to ensure proper initiation, review, and execution. *see also* Hot Work; Work Permit.

**3.1.204 Collection Efficiency** — The percentage of a specific substance removed and retained from the air by an air cleaning or sampling device. It is a measure of the performance of the cleaner or sampling device.

**3.1.205 Coefficient of Discharge** — The ratio of the measured relieving capacity to the theoretical relieving capacity.

**3.1.206 Compatibility** — The ability of materials to exist in contact without specified (usually hazardous) consequences under a defined scenario.

**3.1.207 Conservative Result, Model, or Design** — A procedure where small or large values are assigned to unknowns during consequence modeling. This insures that the resulting engineering design to mitigate or remove the hazard is over designed.

**3.1.208 Cold Trap** — A sampling vessel that has been immersed in a cooling system, such as dry ice or liquid nitrogen, to extract the contaminants from the airstream for subsequent analysis.

**3.1.209 Color Density Tube** — A detector tube that uses color intensity (or density) to determine the amount of compound present.

**3.1.210 Calorimetric (calorimetry)** — A measuring method that uses a change in color as an indication of the concentration of a compound.

**3.1.211 Combination Capacity Factor** — The ratio of average flow capacity determined by tests of a pressure relief valve in combination with a rupture disk device to the flow capacity of the pressure relief valve alone.

**3.1.212 Combustible** — Any material capable of combustion.

**3.1.213 Combustible Dust** — Particulate material that when mixed in air, will burn or explode.

**3.1.214 Combustible Liquid** — Term commonly used for liquids that emit burnable vapors or mists. Technically, a liquid whose vapors will ignite at a temperature of 100 °F or above.

**3.1.215 Combustible Gas Indicator** — A general survey instrument capable of measuring a wide range of air contaminants but cannot distinguish among them. They are usually used as area samplers to measure concentrations that are immediately dangerous to life and health, and concentrations that are within occupational exposure limits, in the ppm range.

**3.1.216 Combustion** — The action or the process of burning, usually associated with the development of light, heat and chemical combination.

**3.1.217 Common Cause Failure** — Failure of two or more structures, systems, and components due to a single specific event or cause. Typical examples include a design deficiency, a manufacturing deficiency, operation and maintenance errors, a natural phenomenon, a human-induced event, saturation of signals, or an unintended cascading effect from any other operation or failure within the plant or from a change in ambient conditions.

**3.1.218 Common Mode Failure** — An event having a single external cause with multiple failure effects which are not consequences of each other.

**3.1.219 Compensable Injury** — An occupational injury or illness resulting in sufficient disability to require the payment of compensation as prescribed by law. A work injury or illness for which compensation benefits are payable to the worker or beneficiary under worker compensation laws.

**3.1.220 Compound** — A substance composed of two or more elements joined according to the laws of chemical combination. Each compound has its own characteristic properties different from those of its constituent elements.

**3.1.221 Compound Hood** — A hood that has two or more points of significant energy (i.e., static pressure) loss.

**3.1.222 Compressed Gas** — A gas which exerts a pressure of at least 41 psi in the container in which it is stored.

**3.1.223 Compressibility** — The relative variation of volume with pressure; depends on the process to which a gas is subjected.

**3.1.224 Concentration**

**3.1.224.1** The amount of given substance in a stated unit of measure. Common methods of stating concentration are percent by weight or by volume; weight per unit volume; normality, etc.

**3.1.224.2** The quantity of a chemical per unit volume; 10 000 ppm = 1 percent. In air, the relationship between ppm and mg/m<sup>3</sup> is as follows:

$$V \times MW = 24.45 \times \text{mg/m}^3$$

where

$V$  = volume ratio of a chemical in air, in parts per million;  
 $MW$  = the chemical's molecular weight;  
 24.45 = number of liters occupied by 1 mole of any gas at STP (i.e. 298 K or 25 °C [77 °F] and 760 mmHg or 1 atm; mg/m<sup>3</sup> = the chemical's concentration in air expressed in milligrams of chemical per cubic meter of air.

**3.1.225 Concentration-time (C-T)** — Two factors on which dosage is based.

**3.1.226 Condensation** — Act or process of reducing from one form to another denser form such as steam to water.

**3.1.227 Conduction**

**3.1.227.1** Transmission of energy by a medium that does not involve movement of the medium itself.

**3.1.227.2** Conductive heat transfer when there is direct contact between a hotter and a colder substance.

**3.1.228 Conflagration** — A fire extending over a considerable area, and destroying numbers of buildings and/or substantial amounts of property.

**3.1.229 Congener** — Compound with related but not identical structure.

**3.1.230 Conjugate** — The product of reaction of an exposing single chemical or a single metabolite with the endogenous biochemical pathways of the body.

**3.1.231 Constraint** — A restriction or a compelling force affecting freedom or action. Forcing into a holding within close bounds. An operational condition that may necessitate work performance in a less than ideal, potentially unsafe environment (e.g., building construction) and that therefore requires the provision of special safeguards.

**3.1.232 Consequence** — The cumulative, undesirable result of an incident, usually measured in health/safety effects, environmental impacts, loss of property, and business interruption cost.

**3.1.233 Consequence Analysis** — The analysis of the expected effects of incident outcome cases independent of frequency or probability.

**3.1.234 Conservation of Mass** — In all ordinary chemical changes, the total mass of the reactants is always equal to the total mass of the products.

**3.1.235 Constant Flow** — A feature available on air sampling pumps whereby the flow rate will automatically compensate for flow restrictions, thereby ensuring that the flow rate is held constant throughout the sampling period.

**3.1.236 Constant Volume Pump** — A sampling pump designed to draw a fixed volume of air with each full pump stroke.

**3.1.237 Contact Hazard** — A potential injury source arising from exposure to a machine, equipment, or a process system that contains sharp surfaces, sharp projections, heat, or extreme cold.

**3.1.238 Container** — Anything that holds material, including storage tanks, pipelines and packaging (drums, carboys, etc).

**3.1.239 Contaminated** — Containing potentially harmful material.

**3.1.240 Contamination** — A release of hazardous material from its source to people, animals, the environment or equipment.

**3.1.241 Containment** — A system condition in which under no condition reactants or products are exchanged between the chemical system and its external environment.

**3.1.242 Contingency Plan** — A document setting out an organized, planned, and coordinated course of action to be followed in case of a fire, explosion, or other incident that releases toxic chemicals, hazardous waste,

or radioactive materials that threaten human health or the environment.

**3.1.243 Continuous Reactors** — Reactors that are characterized by a continuous flow of reactants into and a continuous flow of products from the reaction system. Examples are the Plug Flow Reactor and the Continuous-flow Stirred Tank Reactor.

**3.1.244 Continuous Stirred Tank Reactor (CSTR)** — an agitated tank reactor with a continuous flow of reactants into and products from the agitated reactor system; ideally, composition and temperature of the reaction mass is at all times identical to the composition and temperature of the product stream.

**3.1.245 Controlled Area** — A specific area that is restricted due to an identified hazard.

**3.1.246 Control Measures** — The overall strategy for controlling the environment as well as the specific components that make up that strategy. These include local exhaust and general ventilation, process isolation or enclosure, shielding from heat, ionizing radiation, ultraviolet light, or any other forms of radiant energy, protective clothing, and respiratory protective devices and other controls.

**3.1.247 Controlled Flame Combustion** — The combustion of waste in conditions such that only fully oxidized volatile products are produced, together with ash.

**3.1.248 Convection**

**3.1.248.1** The transfer of heat by the flow of some liquid or gas.

**3.1.248.2** Motion resulting in a fluid from the difference in density and the action of gravity; heat loss or gain by the body to the surrounding atmosphere.

**3.1.249 Conventional Safety Relief Valve** — A conventional safety relief valve has its spring housing vented to the discharge side of the valve. The operating characteristics (opening pressure, closing pressure, and relieving capacity) are directly affected by changes of the back pressure on the valve.

**3.1.250 Cooling Probe** — A probe used in high temperature applications to cool the sample before entry into the detector tube. It sometimes is called a hot air probe.

**3.1.251 Cool Flame Ignition** — A relatively slow self-sustaining barely luminous gas phase reaction of the sample or its decomposition products with an oxidant. Cool flames are visible only in a darkened area. They are self-sustaining exothermic ignition reactions that under proper circumstances may act as the initiator of more energetic hot flame reactions.

**3.1.252 Corrosive** — Chemicals which readily tend to attack materials in contact.

**3.1.253 CPQRA** — The acronym for Chemical Process Quantitative Risk Analysis. It is the quantitative (numerical) evaluation of incident consequences and frequencies and their combination into an overall measure of risk when applied to the chemical process industry. It is particularly applied to episodic events. The CPQRA process is always preceded by a qualitative systematic identification of process hazards.

**3.1.254 Cradle-to-Grave or Manifest System** — A procedure in which hazardous wastes are identified as they are produced and are followed through further treatment, transportation, and disposal by a series of permanent, linkable, descriptive documents.

**3.1.255 Crash Safety** — A system characteristic that allows the system occupants to survive the impact of a crash and to evacuate the system after potentially survivable incidents.

**3.1.256 Crashworthiness** — The capacity of a vehicle to act as a protective container and energy absorber during impact conditions.

**3.1.257 Credible Event** — A scenario or event that has reasonable and sufficient likelihood of occurrence that it should be considered in selecting the design basis for an emergency relief system. This should be based on a risk analysis that includes a careful and thorough review of process characteristics, experience with similar systems, hazardous nature of the materials handled and consequences of an incident.

**3.1.258 Critical Function** — An operation or activity that is essential to the continuing survival of a system. Those functions that have a major impact on system performance and safety.

**3.1.259 Critical Incident Technique** — A set of procedures for collecting direct observations of human behavior in such a way as to facilitate their potential usefulness in solving practical problems and developing broad psychological principles. The critical incident technique outlines procedures for collecting observed incidents having special significance and meeting systematically defined criteria. A randomly selected sample of critical incidents should permit an inference to be made concerning the existence of similar incidents within the population from which the sample was taken.

**3.1.260 Critical Half Thickness** — An estimation of the half thickness of a sample in an unstirred container, in

which the heat losses to the environment are less than the retained heat. This buildup of internal temperature leads to a thermal run away reaction.

**3.1.261 Critical Coolant Temperature** — The maximum temperature of coolant, either gas or liquid, at which all heat generated by a chemical reaction can still be transferred to the coolant.

**3.1.262 Critical Mass** — The minimum mass required to enable the occurrence of an explosion under specified conditions.

**3.1.263 Critical Pressure** — The pressure required to liquefy a gas at its critical temperature.

**3.1.264 Critical Temperature** — Saturation temperature corresponding to the critical state of the substance at which the properties of the liquid and vapor are identical; the temperature above which a gas cannot be liquefied by pressure alone.

**3.1.265 Critical Steady-State Temperature (CSST)** — The highest ambient temperature at which self-heating of a material as handled (in a package, container, tank, etc.) does not result in a runaway but remains in a stationary condition (see Self-Accelerating Decomposition Temperature).

**3.1.266 Cross Sensitivity** — The tendency of detector tubes to respond to more than one compound.

**3.1.267 Cryogenic** — A material at a very low temperature.

**3.1.268 Cryogenic Liquid** — A refrigerated liquefied gas having a boiling point less than  $-90^{\circ}\text{C}$  ( $-130^{\circ}\text{F}$ ) at 101.3 kPa (14.7 psi). It is a hazard due to its freezing temperature, and the evaporation of the liquid at ambient temperatures may be an asphyxiant, especially in low-lying areas.

**3.1.269 Cumulative Injury** — An injury caused by repeated events or repeated exposures at work, such as the loss of hearing due to constant loud noise.

**3.1.270 Cumulative Risk** — The risk of a common toxic effect associated with concurrent exposure by all relevant pathways and routes of exposure to a group of chemicals that share a common mechanism of toxicity.

**3.1.271 Curtain Area** — The area of the cylindrical or conical discharge opening between the seating surfaces created by the lift of the disk above the seat. Refers to the flow area of a pressure relief valve.

**3.1.272 Cutaneous Hazards** — Chemicals that irritate or otherwise damage the skin.



## D

**3.1.273 Dalton's Law** — Also known as Dalton's law of partial pressure. According to this law, at constant temperature, the total pressure exerted by a mixture of gases in a definite volume is equal to the sum of the individual pressures that each gas would exert if occupying the same total volume above. Each constituent of a mixture of gases behaves thermodynamically as if it alone occupied the space. The sum of the individual pressures of the constituents equals the total pressure of the mixture.

**3.1.274 Damage** — Loss in value, usefulness, etc., to property or things. Harm causing any material loss. Severity of injury or the physical, functional, or monetary loss that could result if hazard is not controlled.

**3.1.275 Damage Control** — A term used in the maritime industry and navies for the emergency control of situations that may cause the sinking of a vessel or other serious harm to its operation.

**3.1.276 Danger** — A general term denoting liability or potential of injury, illness, damage, loss, or pain.

**3.1.277 Danger Analysis** — A qualitative safety review methodology, primarily utilized in project management, to identify hazards in activities or systems, their probability of occurrence, and determine if protection measures are adequate. It is similar to a Job Safety Analysis. It is sometimes called a Danger Analysis, Safety Verification, or Preliminary Danger Analysis.

**3.1.278 Danger Label or Sign** — A sign or label that indicates a hazardous situation that if not avoided, could result in death or serious injury.

**3.1.279 Danger Tag** — (5), The tag used in major hazard situations where an immediate hazard presents a threat of death or serious injury to employees.

**3.1.280 Danger Tree** — In the logging industry it refers to a standing tree that presents a hazard to employees due to certain conditions including, but not limited to, deterioration or physical damage to the root system, trunk, stem or limbs, and the direction and lean of the tree.

**3.1.281 Danger Zone** — A physical area or location within which a danger exists. It is typically identified with warning signs, painted ground lines, or through barriers either permanent or temporary.

**3.1.282 Dangerous** — Attended with risk; hazardous; unsafe. Something that if in normal use, danger or injury can be anticipated by the user. Something without adequate protection.

**3.1.283 Dangerous, Imminently** — Something, by reason of defective construction, that causes an impending or threatening dangerous situation, which could be expected to cause death or serious injury to persons in the immediate future unless corrective measures are taken.

**3.1.284 Dangerous, Inherently** — Something that is usually dangerous even in its normal or non-defective state, such as explosives or poisons, and requires special precautions and warnings so as to prevent injury.

**3.1.285 Dangerous Failure** — A failure of a component in a safety instrumented function that prevents that function from achieving a safe state when it is required to do so.

**3.1.286 Dangerous Goods** — Also referred to as hazardous materials. Any solid, liquid, or gas that can harm people, other living organisms, property, or the environment.

**3.1.287 Dangerous when Wet** — Materials that when exposed to water allow a chemical reaction to take place and often produce flammable or poisonous gases, heat and a caustic solution. An example is sodium.

**3.1.288 Decision Tree** — A flow chart designed to assist detector tube users in determining sampling strategies and interpreting results.

**3.1.289 Decompose** — Breaking apart into smaller different chemicals.

**3.1.290 Decomposition** — To undergo chemical breakdown, separating into constituent parts or elements or into simpler compounds.

**3.1.291 Decomposition Energy** — The maximum amount of energy which can be released upon decomposition. The product of decomposition energy and total mass is an important parameter for determining the effects of a sudden energy release — for example, in an explosion. The decomposition energy can occasionally be obtained from the literature or calculated theoretically.

**3.1.292 Decomposition Temperature** — see auto decomposition temperature.

**3.1.293 Decontamination** — Removal of noxious chemicals, harmful bacteria or other organisms from exposed individuals, rooms and furnishings in buildings, or the exterior environment.

**3.1.294 Degradation** — A deleterious change in one or more physical properties of a protective material caused by contact with a chemical.

**3.1.295 Delayed Hazard** — An adverse effect that has the potential to occur after an extended period of time.

Particularly featured in harmful health effects.

**3.1.296 Dense Gas** — A gas with density exceeding that of air at ambient temperature.

**3.1.297 Dependent Failure** — A failure of multiple devices due to some common cause. Ex: The failure of all temperature sensors in a system due to mis calibration during maintenance.

**3.1.298 Depressurization** — The release of unwanted gas pressure from a vessel or piping system to an effective disposal system to prevent the rupture of equipment or for the quick managed disposal of gas to prevent its uncontrolled release.

**3.1.299 Defensive Measures** — Measures taken to reduce or mitigate the consequences of a runaway to an acceptable level.

**3.1.300 Derivitization** — The process of trapping an airborne chemical onto a sorbent material or filter that has been pretreated with a chemical reagent, thereby causing a chemical reaction that produces a stable compound for analysis.

**3.1.301 Design Basis** — The basis for sizing equipment and associated piping used for process or emergency relief services. This might include the flow rate, composition, pressure and temperature of streams handled under the most severe conditions reasonably expected to occur.

**3.1.302 Design Pressure** — The design pressure of a vessel is at least the most severe condition of coincident temperature and gauge pressure expected during operation. The design pressure is the pressure used in the design of a vessel to determine the minimum permissible thickness or other physical characteristics of the different parts of a vessel (*see* also maximum allowable working pressure).

**3.1.303 Desorption** — Removal of a substance from the surface at which it is absorbed.

**3.1.304 Desorption Efficiency** — A measure of how much of a specific analyte can be recovered from a sorbent; typically expressed as a percent of analyte spiked onto the sorbent.

**3.1.305 Detector Tube** — A hermetically sealed glass tube containing an inert solid or granular material such as silica gel, alumina, pumice or ground glass.

**3.1.306 Detector Tube System** — A measuring device that consists of a pump and a detector tube. Accessories such as stroke counters, hoses, and probes also might be included. The exception of this is a passive dosimeter, which does not use a pump.

**3.1.307 Dew point temperature ( $T_{dp}$ )**

**3.1.307.1** The temperature and pressure at which a gas begins to condense to a liquid.

**3.1.307.2** The temperature at which air becomes saturated when cooled without addition of moisture or change of pressure; any further cooling causes condensation.

**3.1.308 Differential Scanning Calorimetry (DSC)** — A technique in which the difference in energy inputs into a substance and a reference material is measured as a function of temperature, while the substance and the reference material are subjected to a controlled temperature program.

**3.1.309 Differential Set Pressure** — The difference between the set pressure and the superimposed back pressure in the valve bonnet (pressure acting on the top of the valve disk) at the time the valve is called upon to operate.

**3.1.310 Differential Thermal Analysis (DTA)** — A technique in which the temperature difference between a substance and reference material is measured as a function of temperature while the substance and the reference material are subjected to a controlled temperature program.

**3.1.311 Diffusion** — Aerosol particles in a gaseous medium are bombarded by collisions with individual gas molecules that are in Brownian motion. This causes the particles to undergo random displacements known as diffusion. The particle parameter that describes this process is the particle diffusivity (or diffusion coefficient), DB.

**3.1.312 Diffusion System** — A flow-metering system based on diffusion through a defined space.

**3.1.313 Diffusive Sampling** — Passive samplers that rely on the movement of contaminant molecules across a concentration gradient that for steady-state conditions can be defined by Fick's first law of diffusion.

**3.1.314 Dimensions of Risk** — Attributes of risk that affect perception of risk.

**3.1.315 Directional Incident Outcome** — An incident outcome whose consequences produce an effect zone determined by a given wind direction.

**3.1.316 Discharge Rate Model** — Models used to estimate the mass release rate or total quantity released during the discharge of material from a process.

**3.1.317 Dispersion** — The mixing and dilution of contaminate in the ambient environment.

**3.1.318 Dispersion Coefficient** — The standard deviation in a specified direction of the Gaussian distribution model used in atmospheric dispersion. The dispersion coefficient is normally expressed as a function of distance for a given weather stability.

**3.1.319 Dispersion Model** — A mathematical model describing how material is transported and dispersed down wind of a release.

**3.1.320 Displacement**

**3.1.320.1** The linear distance from the initial to the final position of an object moved from one place to another, regardless of length of path followed.

**3.1.320.2** The distance of an oscillating particle from its equilibrium position.

**3.1.321 Disposal** — Final placement or destruction of toxic or other wastes; surplus or banned pesticides or other chemicals; polluted oils; and drums containing hazardous materials from removal actions or accidental releases. Disposal may be accomplished through use of approved secure landfills, surface impoundments, land farming, deep-well injection, ocean dumping or incineration.

**3.1.322 Disproportionation** — A chemical reaction in which a single compound serves as both oxidizing and reducing agent and is thereby converted into a more oxidized and more reduced derivative. For example, a hypochlorite upon appropriate heating yields a chlorite or a chloride, and ethyl radicals formed as intermediates are converted into ethane and ethylene.

**3.1.323 Disk (valve)** — A disk is the pressure containing movable element of a pressure relief valve which effects closure.

**3.1.324 Distribution** — Once a chemical has entered the body, it might need to be transported to other sites to induce toxic effects.

**3.1.325 Domino Effects** — The triggering of secondary events, such as toxic releases, by a primary event, such as an explosion, such that the result is an increase in consequences or area of an effect zone. Generally only considered when a significant escalation of the original incident results.

**3.1.326 Dose** — The amount of a chemical administered to an organism.

**3.1.327 Double Contingency Principle** — The simultaneous failure of two components. Most risk analyses do not consider the simultaneous failure of two components a high probability, unless the system under review is of very high criticality, and therefore its reliability is of concern.

**3.1.328 Dry Chemical** — One of the many types of fire extinguishers. The composition depends on the type of fire being fought against. The usual ones encountered are sand, sodium chloride, sodium bicarbonate, graphite, magnesium carbonate, magnesium oxide or a mixture of any or all of these.

**3.1.329 Dry Chemical Extinguisher** — An extinguisher containing a chemical that extinguishes fire by interrupting the chain reaction, wherein the chemicals used prevent the union of free radical particles in the combustion process so that combustion does not continue when the flame front is completely covered with the agent.

**3.1.330 Dry Powder Extinguisher** — A fire extinguisher designed for use on combustible metals fires, such as sodium, titanium, uranium, zirconium, lithium, magnesium, and sodium-potassium alloys.

**3.1.331 Dry Adiabatic Lapse Rate (DALR)** — The negative of the temperature gradient established as dry air ascending in the atmosphere. For air with a molecular weight of 29 and a specific heat ratio of 1.41 the DALR = 0.995 °C/100 m.

**3.1.332 Dry Bulb Temperature ( $T_{db}$ )** — Temperature of air as determined by a standard thermometer. Temperature units are expressed in degrees Celsius (°C), Kelvin (K) ( $K = °C + 273$ ), or degrees Fahrenheit (°F) ( $F = 9/5 °C + 32$ ).

**3.1.333 Drying Train** — A device used to dry a flow of or liquid by chemical absorption.

**3.1.334 Duplicate Sample** — A sample collected in the same location and manner as an actual sample and used to evaluate the entire sampling/analysis method.

**3.1.335 Duration** — The time required for the blast over pressure pulse to return to ambient pressure.

## E

**3.1.336 Effective Discharge Area** — A nominal or computed area of flow through a pressure relief valve, differing from the actual discharge area, for use in recognized flow formulas to determine the capacity of a pressure relief valve.

NOTE Also termed the —orifice area.

**3.1.337 Ejection Hazard** — A form of machinery exposure, whereby particles or items are emitted or thrown off by a machine, which may lead to an injury. A shield or barrier is a protective device to guard against this immediate hazard.

**3.1.338 Electrical Hazard** — A condition that exists where contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

**3.1.339 Electrically Safe Work Condition** — A state where an electrical conductor or circuit part has to be disconnected from energized parts, locked and tagged in accordance with established standards, tested to ensure the absence of voltage, and, if necessary, grounded.

**3.1.340 Electrochemical Detector** — An electrochemical detector responds to compounds (such as phenols, aromatic amines, ketones, aldehydes, and mercaptans) that can be readily oxidized or reduced. Electrode systems use working and reference electrodes to quantify analytes over a range of six orders of magnitude.

**3.1.341 Electrochemical Sensors** — Sensors used by a variety of instruments dedicated to monitoring specific single gas and vapor contaminants. Electrochemical sensors are available for up to 50 different individual gases, including oxygen, carbon monoxide, nitric oxide, nitrogen dioxide, hydrogen sulfide, hydrogen cyanide and sulfur dioxide.

**3.1.342 Electrolyte** — A chemical compound that when molten or dissolved in certain solvents, usually water, will conduct an electric current.

**3.1.343 Electromagnetic Radiation** — The propagation, or transfer, of energy through space and matter by time-varying electric and magnetic fields.

**3.1.344 Electromagnetic Spectrum** — The total range of wavelengths or frequencies of electromagnetic radiation, extending from the longest radio waves to the shortest known cosmic rays. Any location on the spectrum may be characterized by wavelength, frequency and photon energy.

**3.1.345 Electromagnetic Susceptibility** — A problem experienced with sampling equipment due to electromagnetic fields in the environment that might result in errors or malfunctions in operation.

**3.1.346 Electron Capture Detector (ECD)** — Extremely sensitive gas chromatography detector that is a modification of the argon ionization detector, with conditions adjusted to favor the formation of negative ions.

**3.1.347 Electron Equilibrium** — A point or area in a radiation detector in which the number of electrons entering equals the number of electrons leaving the local point volume.

**3.1.348 Electronic Gas Detector** — A device for detecting and measuring flammable gases based on their reaction with an electric filament. The resulting combustion and rise in temperature can be detected electronically and displayed as a concentration in air.

**3.1.349 Electrostatic Precipitator** — An air-cleaning device that involves the following steps: electrical charging of suspended particulate matter; collection of charged particles on a grounded surface; and removal of particulates from the collecting surface by mechanical vibration or flushing with liquid.

**3.1.350 Element** — Solid, liquid or gaseous matter that cannot be further decomposed into simpler substances by chemical means.

**3.1.351 Electron Volt (eV)** — A unit of energy equivalent to the amount gained by an electron in passing through a potential difference of one volt. Large multiple units of the electron volt are frequently used, such as KeV for kilo electron volts (1 000 eV), MeV for million electron volts (10<sup>6</sup> eV), and BeV for billion electron volts (10<sup>9</sup> eV).

**3.1.352 Emergency** — A non-routine situation that necessitates prompt remedial action, primarily to mitigate a hazard or adverse consequences for human health and safety, quality of life, property, or the environment. This includes conventional emergencies such as fires, release of hazardous chemicals, storms, or earthquakes. It also includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard.

**3.1.353 Emergency Action** — An action performed to mitigate the impact of an emergency on human health and safety, property, or the environment.

**3.1.354 Emergency Alarm** — A warning device, usually visual or auditory, that indicates the existence of an emergency situation requiring immediate action.

**3.1.355 Emergency Exposure Limit (EEL)** — The maximum amount of a toxic agent to which an individual can be exposed for a very brief (emergency) period of time and still maintain physical safety.

**3.1.356 Emergency Isolation Valve (EIV)** — A valve that, in event of fire, rupture, or loss of containment, is used to stop the release of flammable or combustible liquids, combustible gas, or potentially toxic material. An EIV can be either hand operated or power operated (air, hydraulic, or electrical actuation). EIVs can be actuated either by an emergency shutdown (ESD) system or by a local or remote actuating button, depending on the design of the facility.

**3.1.357 Emergency Management Agency** — The state and local agencies responsible for emergency operations, planning, mitigation, preparedness, response, and recovery for all hazards.

**3.1.358 Emergency Operations Plan** — The steady-state plan maintained by various jurisdictional levels for responding to a wide variety of potential hazards.

**3.1.359 Emission**

**3.1.359.1** Material released into the air either by a primary source or a secondary source, as a result of a photochemical reaction or chain reactions.

**3.1.359.2** Any radiation of energy by means of electromagnetic waves, as from a radioactive transmitter.

**3.1.360 Emission or Exposure Control** — The technical and administrative procedures applied for the reduction or elimination of emissions from the source or of exposure to the target.

**3.1.361 Emission Standard** — This regulatory value is a quantitative limit on the emission or discharge potentially toxic substance from a source. *see* limit values

**3.1.362 Emergency Shutdown (ESD) System** — The safety control system which overrides the action of the basic control system when predetermined conditions are violated.

**3.1.363 Emergency Vent** — A vent designed to respond to an overpressure or temperature excursion in protected equipment by opening and discharging materials from the equipment to relieve excessive pressure. This is commonly a pressure relief device.

**3.1.364 Emergency Services** — The local off-site response organizations that are generally available and that perform emergency response functions. These may include police, fire fighters and rescue brigades, ambulance services, and control teams for hazardous materials.

**3.1.365 Emergency Shutdown (ESD)** — A control feature to safely stop a process. An emergency shutdown generally consists of stopping equipment, closing isolation valves on the supply or discharge lines from the process, or causing the system to be depressurized. The emergency shutdown features chosen for a particular process are dependent on the hazards of the process materials, quantities involved, arrangement of equipment, and exposures.

**3.1.366 Emergency Shutdown Button** — An operator control, usually a push-button with a large, red, protruding mushroom head, that when actuated initiates an emergency stop.

**3.1.367 Emergency Shutdown System** — A system composed of sensors, logic solvers, and final control elements for the purpose of taking the process, or specific equipment in the process, to a safe state when predetermined conditions are violated. The system is designed to isolate, de-energize, shut down, or de-pressure equipment in a process unit.

**3.1.368 Emergency Shut-off** — A switch placed in a convenient position for cutting off the supply of electricity to a piece of equipment or to a building, in case of emergency.

**3.1.369 Emergency Stop** — Arrest of dangerous machine motion resulting from actuation of an emergency stop switch. The switch may be in the form of a safety switch, button, trip cable, or foot barer other mechanical device used in conjunction with an emergency stop safety module.

**3.1.370 Emission Control** — Engineering measures, including devices, used to prevent worker exposure to contaminants that are released within the workplace. The term also refers to measures used on internal combustion engines, exhaust stacks, and other emission sources that are used to protect the general public.

**3.1.371 Employee Exposure Records** — Information results or records concerning employee exposures to harmful substances or agents in the workplace, such as inventories of chemicals, material safety data sheets, and work area sampling results.

**3.1.372 Endothermic** — A physical or chemical change that requires or is accompanied by the absorption of heat.

**3.1.373 Energy**

**3.1.373.1 Capacity to do work.**

**3.1.373.2** Having several forms that may be transformed from one to another such as thermal (heat), mechanical (work), electrical and chemical.

**3.1.374 Energy Spectrum** — The orderly separation of the components of a beam of radiation according to their wavelengths, frequencies for quantum energies.

**3.1.375 Entrainment** — The suspension of liquid as an aerosol in the atmospheric dispersion of a two-phase release or the aspiration of air into a jet discharge.

**3.1.376 Enthalpy of Reaction** — The net difference in the enthalpies of formation of all of the products and the enthalpies of all of the reactants; heat is released if the net difference is negative.

**3.1.377 Environmental Conditions** — Natural or controlled conditions of air and radiation prevailing around a person, an object, a substance etc.

**3.1.378 Environmental Monitoring** — Program in which samples of air contaminants or energy measurements are taken and which establishes the level of worker exposure to such agents.

**3.1.379 Environmental Transformation** — Once emitted into the environment, a chemical substance may be transported in the biosphere and undergo various types of chemical changes.

**3.1.380 Environmental Quality** — Any standard specifying lower limits for contaminants, chemical or physical agents, and/or resulting stresses to the human body in order to maintain a particular, healthful, and safe environment in which to work.

**3.1.381 Episodic Release** — A release of limited duration, usually associated with an accident.

**3.1.382 Equation of State** — An equation that relates the pressure (P), volume (V), and thermodynamic temperature (T), and an amount of substance (n). The simplest form is the Ideal Gas Law:  $PV = nRT$ .

**3.1.383 Equilibrium** — Condition in which a particle, or all the constituent particles of a body at rest or in unaccelerated motion in an inertial reference frame.

**3.1.384 Equipment Reliability** — The probability that, when operating under stated environment conditions, process equipment will perform its intended function adequately for a specified exposure period.

**3.1.385 Equivalent Ideal Nozzle Area** — The product of the nozzle area and the coefficient of discharge.

**3.1.386 Ergonomic Hazard Prevention and Control** — Elimination or minimizing the ergonomic hazards identified in a worksite analysis through reduction of the frequency, duration, and severity of the exposure to the hazard. It includes work methods training, job rotation, gradual work introduction, and changes in the workstation, tools, or environment to fit the individual.

**3.1.387 Es of Safety, the Three (3Es)** — The supervisory duties of maintaining and improving safety through Engineering, Education, and Enforcement. Engineer hazards out of the workplace, educate employees in safe work practices and procedures, and enforce all safety rules and policies.

### **3.1.388 Evaporation Rate**

**3.1.388.1** The ratio of the time required to evaporate a measured volume of a liquid to the time required to evaporate the same volume of a reference liquid under ideal test conditions. The higher the ratio, the slower the evaporation rate.

**3.1.388.2** The rate at which a material is converted from the liquid or solid state to the vapor state; may be expressed relative to the evaporation rate of a known material, usually n-Butyl acetate (with an evaporation rate of 1.0 by definition). Faster evaporation rates are  $> 1$ , and slower evaporation rates are  $< 1$ .

**3.1.389 Exhaust (General)** — Diluting the general room atmosphere with outdoor air fast enough to keep the concentration of toxic vapor in the room air within safe limits. It may also be known as General Ventilation or Dilution Ventilation.

**3.1.390 Exhaust (Local)** — A local exhaust system is used to collect air contaminants at the source, as contrasted with general ventilation, which allows the contaminant to spread throughout the workroom, later to be diluted by exhausting quantities of air from the room. Local exhaust may be achieved using an enclosure, a receiving hood, or an exterior hood.

**3.1.391 Exhaust Ventilation** — The removal of air or other gas from any work space, usually by mechanical means.

**3.1.392 Exit** — The portion of an exit route that is generally separated from other areas to provide a protected way of travel to the exit discharge from the effects of an incident. An example of an exit is a 2 hour fire-resistance-rated enclosed stairway that leads from the fifth floor of an office building to the outside of the building. Exits include exterior exit doors, exit passageways, horizontal exits, and separated exit stairs or ramps.

**3.1.393 Exit Sign** — A designated identification label provided at or near an exit that is clearly recognizable and identifies the exit or the path to an exit. Some codes require red exit signs and others green. Red is usually associated with fire and exit lights and green for safety.

**3.1.394 Exothermic** — A process or chemical reaction that is accompanied by release of heat.

**3.1.395 Expected Number of Failures (ENF)** — The average number of occurrences of the fault event during a specified time interval.

**3.1.396 Explode** — The rapid expansion of a material or container with the release of energy, heat or pressure.

**3.1.397 Explosive** — Any substance designed to produce an explosion (i.e. an extremely rapid release of gas and heat) or capable of producing an explosion by reacting with itself.

**3.1.398 Exposure** — Contact between a chemical, physical, or biological agent and the outer surfaces of an organism. Exposure to an agent does not imply that it will be absorbed or that it will produce an effect.

**3.1.399 Exposure, Casualty** — Proximity to a condition that may produce injury, death, or damage from dusts, chemicals, high pressure, explosives, etc.

**3.1.400 Exposure, Occupational** — The quantity of time involved, and the level (quantity) and nature (quality) of employee involvement with certain types of environments possessing various degrees or types of hazards in the course of their work.

**3.1.401 Exposed or Non-Exposed** — Qualitative terms defining the existence of or lack of a hazard in the environment of individuals.

**3.1.402 Exposure Assessment** — The quantification of the amount of exposure to a hazard for an individual or group.

**3.1.403 Exposure Level** — The level or concentration of a physical or chemical hazard to which an employee is exposed.

**3.1.404 Exposure Limit** — A general term implying the level of exposure that should not be exceeded.

**3.1.405 Exposure Records** — The records kept by an employer, or company doctor or nurse of an employee's exposure to a hazardous material or physical agent in the workplace. These records show the time, level, and length of exposure for each substance or agent involved.

**3.1.406 Extinguisher** — Any agent used to fight fire with a view to put it out.

**3.1.407 Extinguishing Agent** — Material or substance that performs a fire extinguishing function. Common extinguishing agents are water, carbon dioxide, dry chemical, alcohol foam, and halogenated gases (Halon). It is important to know which extinguishers can be used so they can be made available at the worksite. It is also important to know which agents cannot be used since an incorrect extinguisher may not work or may create a more hazardous situation. If several materials are involved in a fire, an extinguisher effective for all of the materials should be used. Sometimes referred to as Extinguishing Media.

**3.1.408 Extrapolation** — The calculation, based on quantitative observations in exposed test species, of predicted dose-effect and dose-response relationships for a chemical in humans and other environmental biota.

## F

**3.1.409 Face Shield** — A protective device designed to prevent hazardous substances, dust particles, sharp objects, and other materials from contacting the face or eyes. It may be worn over safety glasses or goggles.

**3.1.410 Facepiece** — The portion of a respirator that covers the user's nose and mouth in a half-mask facepiece, or the nose, mouth, and eyes in a full facepiece. It is designed to make a gas-tight or dust-

tight fit with the face and includes the headband, exhalation valves, band connections for an air purifying device or respirable gas source or both.

**3.1.411 Facility Layout** — The act or process of laying out, or planning in detail, to show the arrangement of equipment and other elements of a facility to establish a safe working environment.

**3.1.412 Factor of Safety** — Ratio of a normal working condition to which the ultimate conditions, such as, in strength of materials, ratio of working stress to ultimate strength.

**3.1.413 Fail-Safe** — Design features which provide for the maintenance of safe operating conditions in the event of a malfunction of control devices or an interruption of an energy source (e.g., direction of failure of a motor operated valve on loss of motive power). Features incorporated for automatically counteracting the effect of an anticipated possible source of failure. A system is fail-safe of failure of a component, signal or utility initiates action that return the system to a safe condition.

**3.1.414 Fail Steady (FS)** — A condition wherein the component stays in its last position when the actuating energy source fails. It may also be called Fail-in-Place.

**3.1.415 Fail to Danger** — A system design or condition such that the failure of a component, subsystem, or system or input to it, will automatically revert to an unsafe condition or state of highest critical consequence for the component, subsystem, or system.

**3.1.416 Failure** — An unacceptable difference between expected and observed performance.

**3.1.417 Failure, Critical** — A failure that could result in major injury or fatality to people or major damage to any system or loss of a critical function.

**3.1.418 Failure Mode** — A symptom, condition, or fashion in which hardware fails. A mode might be identified as a loss of function; premature function (function without demand); and out-of-tolerance condition; or a simple physical characteristic such as a leak (incipient failure mode) observed during inspection.

**3.1.419 Failure, Primary** — The failure that is responsible for a system malfunction.

**3.1.420 Failure, Secondary** — A failure that occurs as the consequence of another failure.

**3.1.421 Failure Analysis** — The logical systematic examination of an item to identify and analyze the cause, mode, and consequence of a real failure.

**3.1.422 Failure Assessment** — The process by which the cause, effect, responsibility, and cost of any reported problem in the system is determined and reported.

**3.1.423 Failure Management** — Decisions, policies, and planning that identify and eliminate or control potential failures and implement corrective or control procedures following real failures.

**3.1.424 Failure Mechanism** — The chemistry of the failure event, i.e., the cause of the failure.

**3.1.425 Failure Mode and Effects Analysis** — A hazard identification technique in which all known failure modes of components or features of a system are considered in turn and undesired outcomes are noted.

**3.1.426 Failure Probability** — The probability—a value from 0 to 1 that a piece of equipment will fail on demand (not to be confused with fractional dead time) or will fail in a given time interval.

**3.1.427 Failure Rate** — The number of failure events that occur divided by the total elapsed operating time during which these events occur or by the total number of demands, as applicable.

**3.1.428 Failure Severity** — The degree of function degradation of equipment usually noted through deficient performance; categorized by the terms "Catastrophic," "Degraded," and "Incipient."

**3.1.429 Fatal Accident Rate (FAR)** — The estimated number of fatalities per 108 exposure hours (roughly 1 000 employee working lifetimes).

**3.1.430 Fault Hazard Analysis** — The analysis of hazards or hazard potential situations using fault tree methodology. *see also* Fault Tree Analysis (FTA).

**3.1.431 Fault Tree** — A method for representing the logical combinations of various system states that lead to a particular outcome (top event).

**3.1.432 Fault Tree Analysis** — Estimation of the hazardous incident (top event) frequency from the logical model of the failure mechanisms of a system.

**3.1.433 Fault Tolerant** — A control system configuration that inherently provides auto selection of alternate or redundant signal paths to effect uninterrupted operations.

**3.1.434 Fibre Pack** — A leak resistant container made of flammable material that is used to collect, store and transport chemicals before they are incinerated.

**3.1.435 Fire** — The chemical combination of oxygen with fuel accompanied by evolution of thermal energy, indicated by incandescence or flame.

**3.1.436 Fire Alarm** — A device or system (visual, auditory, local, or transmitted to other locations, etc.) that signals the presence of a fire to occupants and those who will provide assistance.

**3.1.437 Fire Alarm Control Panel (FACP)** — A control system for receiving fire alarm signals and initiating actions to highlight conditions (alarms and beacons) or institute actions to automatically activate fire protective systems (i.e., fire pump startup, HVAC shutdown, etc.). The fire alarm control panel also provides an indication of the fire detection activation point through an annunciator panel or area and zone indicator lights, which highlight the specific location in a facility from where an alarm has been initiated. The FACP is required to meet specific performance requirements for reliability.

**3.1.438 Fire Class** — A simple letter designation given to a particular fire category for the purposes of generally classifying (severity and hazard) the fire according to the type of fuel and possible spread of the fire and type of extinguisher agent to use for it. A is used for ordinary combustibles (wood, cloth, paper, rubber, and many plastics), B for flammable liquids and gases (oils, liquid fuels, lubrication oils, hydraulic fluids, greases, tars, oil-based paints, lacquers, aerosols, cleaning compounds, and cutting or fuel gases), C for energized electrical fires, and D for combustible metal fires (magnesium, titanium, zirconium, sodium, or potassium).

**3.1.439 Fire Code** — A regulatory document for the implementation of measures to prevent the occurrence, spread, and institute suppression capability for unwanted fires. Enforcement is maintained by state Fire Inspectors and Fire Marshals. Most codes are determined by consensus agreement and therefore may not represent the highest or lowest level of protection that may be available, but what has been determined as appropriate by the experienced members determining the fire code specifications. Most fire codes have been prescriptive in nature, i.e. specifying exact requirements; however, the trend has been to provide performance-based codes that require a specific outcome and allow the detailed requirements to be determined by the premises owner as long as they meet the performance requirements.

**3.1.440 Fire Detection** — A device for the detection and notification of a fire event. Fire alarms can be activated by people or automatic devices that can detect the presence of fire. These include heat-sensitive devices, which are activated if a specific temperature is reached; a rate-of-rise heat detector, which is triggered either by a quick or a gradual escalation of temperature; and smoke detectors, which sense changes caused by the presence of smoke, in the intensity of light, in the refraction of light, or in the ionization of air. The arrangement and type of fire detectors for optimum performance is usually specified by fire codes or industry guidelines.



**3.1.441 Fire Door** — Doors that are rated and tested for resistance to various degrees of fire exposure and utilized to prevent the spread of fire through horizontal and vertical openings. The doors must remain closed normally or be closed automatically in the presence of fire. The degree of resistance required is determined by the type of occupancy, the anticipated fire exposure, and the resistance of the structure in which it is installed.

**3.1.442 Fire Drill** — A planned or unplanned evacuation of a building, facility, or location in order to familiarize and train the occupants in the means of escape to a safe location.

**3.1.443 Fire Ball** — A burning fuel-air cloud whose energy is emitted primarily in the form of radiant heat. The inner core of the cloud consists almost completely of fuel, whereas the outer layer (where ignition first occurs) consists of a flammable fuel-air mixture. As the buoyancy forces of hot gases increase, the burning cloud tends to rise, expand and assume a spherical shape.

**3.1.444 Fire Hazard** — A term that connotes all the implied risks associated with the start and spread of fire.

**3.1.445 Fire Point** — The temperature at which a material continues to burn when the ignition source is removed.

**3.1.446 Fire (Flame) Proof** — Material incapable of burning. The term fire proof is considered false. No material is immune to the effects of a fire possessing sufficient intensity and duration. It is commonly, although erroneously, used synonymously with the term — fire resistive. Use of the term is discouraged since it is misleading.

**3.1.447 Fire Protection** — In general terminology this refers to the prevention, detection, and extinguishment of fire and reduction or avoidance of losses in human terms, assets, business activities, environmental impact, and prestige. In a specific application, it is the providing of fire control or extinguishment. It may also be used to signify the degree to which protection from fire is applied.

**3.1.448 Fire Protection Engineering** — The discipline of engineering that applies scientific and technical principles to safeguard life, property, loss of income, and threat to the environment from the effects of fires, explosions, and related hazards. It is associated with the design and layout of buildings, industrial properties, structures, equipment, processes, and supporting systems. It is concerned with fire prevention, control, suppression, and extinguishment and provides for consideration of functional, operational, economic, aesthetic and regulatory requirements.

**3.1.449 Fire Protection System** — An integrated system that affords protection against fire and its effects. It may be composed of either active or passive fire protection measures. The fire protection system should be commensurate with the level of hazard it is protecting.

**3.1.450 Fire Pump** — A pump specifically designed, designated, and installed to provide adequate and sufficient water supplies for controlling and suppressing unwanted fires. A fire water pump may be driven by an electric motor, diesel engine, or steam turbine. Gasoline engines are not recommended due to their reduced reliability and inherent fire hazard. Fire pumps may be mobile or stationary. Mobile pumps used by fire departments and mounted on trucks are referred to as fire pumpers.

**3.1.451 Fire Resistive** — Refers to properties of materials or designs to resist the effects of any fire to which the material or structure may be expected to be subject. A building constructed of fire-resistive materials can withstand a burnout of its contents without subsequent structural collapse. Fire resistive implies a higher degree of fire resistance than noncombustible.

**3.1.452 Fire Retardant** — In general this denotes a substantially lower degree of fire resistance than fire resistive. The term is frequently used to refer to materials or structures that are combustible but have been subjected to treatments or surface coverages to prevent or retard ignition or the spread of fire.

**3.1.453 Fire Square** — A graphical symbolic representation of the four factors needed for the propagation of combustion or fire. Each side of the square is representative of a factor. The four factors

include fuel, oxidizer, ignition source, and chain reaction. Removal or blockage of one of the elements prevents the combustion process from occurring or continuing.

**3.1.454 Fire Tetrahedron** — A graphical symbolic representation of the four factors needed for the propagation of combustion or fire. Each side of the tetrahedron is representative of a factor. The four factors include fuel, oxidizer, ignition source, and chain reaction. Removal or blockage of one of the elements prevents the combustion process from occurring or continuing.

**3.1.455 Fire Triangle** — Geometric symbolic representation of the combustion process whereby each side of the triangle is one independent element of the process, namely fuel (usually in vapor form), oxidizer, and ignition source (of sufficient energy and high

temperature to initiate a combustion process). Removal of one element of the triangle stops the combustion process. The chain reaction of fire is sometimes indicated in combustion. Liquid mist and finely divided particles that are readily converted to vapor have combustion characteristics much the same as vapors. Carbon and some metals and dusts are an exception in that fuel must be in a vapor form for a combustion process.

**3.1.456 Fire Wall** — A fire-resistant wall designed to prevent the horizontal spread of fire into adjacent areas that is generally self-supporting and designed to maintain its integrity if the structure on either side completely collapses. If a wood roof is involved, the wall must extend through and above the roof.

**3.1.457 First in First Out System** — A method used in chemicals storage and distribution so that there is least chance of accumulating old stocks that may deteriorate or build up hazardous materials.

**3.1.458 Flame (Flash) Arrestor** — Devices utilized on vents for flammable liquid or gas tanks, storage containers, cans, gas lines, or flammable liquid pipelines to prevent flash-back (movement of flame) through the line or into the container when a flammable or explosive mixture is ignited.

**3.1.459 Flame Propagation** — The spread of flame throughout a combustible vapor area, which may be in a container or across a surface, independent of the ignition source. Generally used in connection with the capability and rate of such movement.

**3.1.460 Flameout** — The unexpected loss of a burner flame during furnace operations, which can create potentially explosive conditions due to buildup of combustible vapors.

**3.1.461 Flammable** — Broadly, a flammable material is any solid, liquid or gas that will ignite easily and burn in air rapidly.

**3.1.462 Flammable Gas** — A gas that at ambient temperature and pressure forms a flammable mixture with air at a concentration of 13 percent by volume or less; or a gas that at ambient temperature and pressure forms a range of flammable mixtures with air greater than 12 percent by volume, regardless of the lower explosive limit.

**3.1.463 Flammable Liquid** — A liquid with a flash point less than 100°F (37.8 °C) as specified by NFPA 321 (1991). Class IA flammable liquids have flash points below 73 °F (22.8 °C) and boiling points below 100 °F (37.8 °C). Class IB flammable liquids have flash points below 73°F (22.8 °C) and boiling points at or above 100 °F (37.8 °C). Class IC flammable liquids have flash points at or above 73 °F (22.8 °C) and below 100 °F (37.8 °C).

**3.1.464 Flammable Vapor** — A concentration, by volume, of vapors in air from a flammable liquid within the lower and upper flammable limits.

**3.1.465 Flammability Limit** — A flame can propagate in a mixture of combustible gas and air (or oxygen) only if the concentration of the gas is between two limits known as the lower and upper flammable (exposure) limits.

**3.1.466 Flammable Mass** — The mass of flammable vapor within a vapor cloud that will burn on ignition.

**3.1.467 Flammable Range** — The percentage of fuel vapors in air where ignition can occur. Flammable range has an upper and lower limit.

**3.1.468 Flammable-Storage Cupboard or Container** — A device specially designed for the safe storage of solvents or other flammable materials to avoid their combustion even if they are involved in a fire.

**3.1.469 Flame Ionization Detector (FID)** — A device in which the measured change in conductivity of a standard flame (usually hydrogen) due to the insertion of another gas or vapor is used to detect the gas or vapor.

**3.1.470 Flame Photometric Detector (FPD)** — The flame photometric detector is used to measure phosphorus and sulfur containing compounds such as organophosphate pesticides and mercaptans. The FPD measures phosphorus or sulfur-containing compounds by burning the column effluent in a hydrogen air-flame with an excess of hydrogen. Sulfur and phosphorus compounds emit light above the flame; a filter optimized to pass light at 393 nm is used to detect phosphorus compounds. A photomultiplier tube is then used to quantify the amount of light passing through the selective filter.

**3.1.471 Flare** — The flame condition of a fire in which burning occurs with an unsteady flame. In the process industries (i.e., chemical and petroleum) a flare refers to a primary fire safety system used for the safe remote disposal of gases by burning from normal processes or emergency conditions. Process gases that cannot be safely disposed of may contribute to fire destructiveness or cause a vessel rupture or BLEVE (Boiling Liquid Expanding Vapor Explosion).

**3.1.472 Flash Back** — The ignition of vapors and the travel of the flame back to the liquid/vapor release source.

**3.1.473 Flashpoint Temperature** — The temperature at which a liquid is capable of producing enough flammable vapor to ignite.

**3.1.474 Flash Point** — The lowest temperature of a liquid at which a flame can be propagated across the surface of the liquid when a standard ignition source is applied.

**3.1.475 Flash Fire** — The combustion of a flammable gas or vapor and air mixture in which the flame propagates through that mixture in a manner such that negligible or no damaging over pressure is generated.

**3.1.476 Flux** — In nucleonics, the product of the number of particles per unit volume and their velocity.

**3.1.477 Flow-dilution System** — A system that continuously mixes accurately metered flows of a test component with a diluent.

**3.1.478 Fluids** — A state of matter that flows under pressure (i.e., gas and liquid states)

**3.1.479 F-N Curve** — A plot of cumulative frequency versus consequences (expressed as number of fatalities).

**3.1.480 Foam** — A suspension, often colloidal, of a gas in a liquid. In fire-fighting terminology, a type of extinguisher, produced by bubbling carbon dioxide or some other gas (which is not a supporter of combustion) through a liquid containing foam producing material.

**3.1.481 Fog** — Liquid particles dispersed in air.

**3.1.482 Food Laboratory Safety Programme** — The strict observance of the precept that food and drink are not to be consumed in a chemical laboratory, nor stored in the same place as chemicals for laboratory use. This is especially important with regard to refrigerators, deep freezers and ice-making machines.

**3.1.483 Force** — An interaction of two objects that produces a change in state of motion of an object. A force may cause an object to move, accelerate or decelerate it, change its direction or stop it from moving.

**3.1.484 Force Couple** — The pair of forces arranged to produce pure rotation (angular motion).

**3.1.485 Foreseeability** — The legal theory that a person may be held liable for actions that result in injury or damage only where the person was able to foresee dangers and risks that could reasonably be anticipated.

**3.1.486 Foreseeable Emergency** — Potential occurrence such as equipment failure, rupture of containers, or failure of control equipment, which could result in an uncontrolled release of a hazardous chemical.

**3.1.487 Fractional Dead Time (FDT)** — The mean fraction of time in which a component or system is unable to operate on demand. (Also known as Unavailability).

**3.1.488 Frequency** — Number of occurrences of an event per unit of time.

**3.1.489 Freeze** — To change from a liquid state to a solid state.

**3.1.490 Freeboard** — The clear, vertical space above a liquid or a foam in a vessel.

**3.1.491 Free Radical** — A chemical intermediate having one unpaired electron that can initiate a chain reaction; such a reaction may be self-sustaining or liable to quenching by a scavenger.

**3.1.492 Freezing Point** — For a particular pressure, the temperature at which a given substance will solidify or freeze upon removal of heat. The freezing point of water is 32 °F (0 °C).

**3.1.493 Frequency** — The number of occurrences per unit time at which observed events occur or are predicted to occur.

**3.1.494 Frothover** — When water is present or enters a tank containing hot viscous oil, the sudden conversion of water to steam causes a portion of the tank contents to overflow.

**3.1.495 Frozen** — A term to describe a mixture of vapor and liquid in which the ratio of phases does not change as the mixture moves through a pipe (i.e., neither flashing nor condensation occur).

**3.1.496 Fuel** — Material which either by a process of combustion or nuclear chain reaction is capable of liberating utilizable thermal energy.

**3.1.497 Fume**

**3.1.497.1** Minute solid particles generated by condensation from the gaseous state, generally after volatilization (evaporation) from melted substances, such as welding and often accompanied by a chemical reaction, such as oxidation.

**3.1.497.2** Very small, air borne particles commonly formed by condensing vapors from burning or melting materials.

**3.1.498 Fume Fever** — An acute condition caused by a brief high exposure to the freshly generated fumes of metals.

**3.1.499 Fungicide** — A substance used to kill fungi.

**3.1.500 Function Check** — A function check, or bump test, means using simple tests (such as exposing sensors to calibration gas or exhaling into the oxygen sensor) to show that the instrument will respond to the chemical(s) of concern and that all alarms operate as they were designed.

**3.1.501 Functional Safety Assessment** — Activity performed by a competent senior engineer to determine if the safety system meets the specification and actually achieves functional safety (freedom from unacceptable risk). This assessment is an important part of reducing systematic failures. It must be performed at least after commissioning and validation but before the hazard is present.

**3.1.502 Fuse, Electrical** — A form of electrical circuit protection that comprises a strip of metal of such size to melt at a predetermined value of current flow. It is placed in the electrical circuit, and upon melting, due to excessive current flow, prevents the flow of electricity supply to the circuit.

**3.1.533 Fusible Link** — A release device that is activated by the heat effects of a fire. It typically consists of two pieces of metal joined by a low-melting-point solder. They are manufactured in various temperatures and with varying amounts of applied tension. When installed and the rated temperature is reached, the solder melts and the two metal parts separate, initiating the desired fire safety function.

**3.1.504 Fusible Plug** — A hollowed threaded plug having the hollowed portion filled with a low-melting-point material. This element is often used to provide a mechanical relief device triggered by temperature causing the process fluid to vent when the plug material melts. It is typically used in a pneumatic fire detection system or sprinkler system to indicate the presence of a fire condition and disperse the gas or fluid in the contained system.

**3.1.505 Fusible Link Device** — A non-reclosing pressure relief device designed to function by the yielding or melting of a plug of suitable melting temperature material.

## G

**3.1.506 Gas Chromatograph (GC)** — GC is an instrument that separates molecular mixtures in the gaseous phase. It is used to detect number of chemicals and their concentration in the given sample (it is not known as = mass spectrometer). The mass spectrometer can be used as a detector to GC.

**3.1.507 Gas Chromatography** — A separation technique involving passage of a gaseous moving phase through a column containing a fixed adsorbent phase; it is used principally as a quantitative analytical technique for volatile compounds.

**3.1.508 Gas Constant (R)** — The coefficient (R) in the Ideal Gas Law equation given by  $PV = nRT$ ; the constant factor in the equation of state for ideal gases. In the SI system the units,  $R = 0.082\ 05\ \text{l atm/mole (K)}$ .

**3.1.509 Gas Detector** — A device that detects the presence of various gases within an area, usually as part of a system to warn about gases that might be harmful to humans or animals. Various types of gas detectors are used to detect primarily combustible, toxic, and oxygen levels (i.e., deficiency), and carbon monoxide and carbon dioxide gases. They are typically used in confined spaces, utilities and chemical plants, industrial hygiene applications, and air quality testing. They can be fixed devices or portable devices worn by an individual.

**3.1.510 Gas Mask** — A face covering connected to its own purifying device, which filters harmful gases or pollutants from the air so uncontaminated air may be inhaled. Gas masks do not add oxygen to air and cannot be used where there is oxygen deficiency.

**3.1.511 Gas Narcosis** — Gas narcosis is caused by nitrogen in normal air during dives of more than 120 feet. Helium, substituted for nitrogen in —mixed gas diving, can cause an effect called —high pressure nervous syndrome, beyond 500 fsw.

**3.1.512 Gas Solubility** — The extent that a gas dissolves in a liquid to produce a homogeneous system.

**3.1.513 Gauge Pressure** — The difference between two absolute pressures, one of which is usually atmospheric pressure.

**3.1.514 Genotoxic Chemical** — An electrophilic (i.e., electron-deficient) compound that has an affinity for genetic information, specifically the electron –dense (i.e., nucleophilic) DNA.

**3.1.515 Goggles, Safety** — They seal the entire eye area to protect the eyes against dust, impacting objects, chemical splashes, strong light, sparks, or other harmful environmental influences. They are contoured for full facial contact and held in place by a head-band or other suitable means, and are required to meet *see* IS 14352 and be clearly marked with the manufacturer's name.

**3.1.516 Good Laboratory Practice** — A desirable or mandatory system of laboratory working, incorporating basic safety instructions and appropriate experimental design features.

**3.1.517 Gram Mole** — The amount of substance represented by one gram molecular weight or one gram molecular volume (mole).

**3.1.518 Gram Molecular Weight** — The sum of the individual atomic weights of all the atoms in a molecule.

**3.1.519 Gravimetric Analysis** — A process in which a known volume of aerosol-laden air is drawn through a filter of known initial weight, then reweighing the filter to determine the mass captured.

**3.1.520 Green Cross** — Commonly a symbolic reference to safety or commercially a symbol for pharmacies.

**3.1.521 Grounding** — The procedure or method used to carry an electrical charge to ground through a conductive path to avoid an electrical buildup that may eventually harm individuals from a shock hazard or initiate a fire or explosion as an ignition source. A typical ground may be connected directly to a conductive pipe or to a grounding bus and ground rod.

**3.1.522 Ground State** — The state of a nucleus, an atom or a molecule, of the lowest energy. All other states are termed 'excited'.

**3.1.523 Guarded** — Protection afforded by being covered, shielded, fenced, enclosed, or otherwise protected by means of suitable enclosures, covers, casings, shields, troughs, railings, screens, mats, or platforms, or by location, to prevent injury.

## H

**3.1.524 Half-time (Pseudo first order)** —  $t_{0.5} = 0.693/k$  where  $k$  is the pseudo first-order process rate constant in units of time.

**3.1.525 Halon** — Halogenated hydrocarbons (contain the elements F, Cl, Br or I) used to suppress or prevent combustion.

**3.1.526 Hand Protection** — The protection of hands from injuries that may result from cuts, abrasions, burns, and from manual handling operations and extremes of temperature. The protection commonly used includes gloves and gauntlets.

**3.1.527 Harm** — Injury (physical or mental) or physical damage.

**3.1.528 Harmful** — Causing or capable of causing harm.

**3.1.529 Hazard** — A chemical or physical condition that has the potential for causing damage to people, property, or the environment.

**3.1.530 Hazard Analysis** — The identification of undesired events that lead to the materialization of a hazard, the analysis of the mechanisms by which these undesired events could occur and usually the estimation of the consequences.

**3.1.531 Hazard Classification** — A designation of relative incident potential based on probability of incident occurrence.

**3.1.532 Hazard Communication (HAZCOM)** — Primarily refers to evaluating the hazard of chemicals used in the workplace and communicating the

information concerning the hazard of chemicals and appropriate protective measures to employees.

**3.1.533 Hazard Control** — That function in an organization directed toward the recognition, evaluation, and reduction or elimination of the destructive effects of hazards emanating from human acts of commission and omission, and from the physical and environmental aspects of the workplace to prevent their re-occurrence.

**3.1.534 Hazard Distance** — The linear distance from the antenna at which the field intensity is reduced to the exposure limit.

**3.1.535 Hazard Elimination** — To remove the probability of an incident occurring, and the chance of individuals being injured or harmed.

**3.1.536 Hazard Evaluation** — Evaluation based on data concerning concentration of a contaminant and duration of exposure.

**3.1.537 Hazard Failure** — An unacceptable difference between expected and observed performance. A chemical, physical or changing condition that has the potential for causing damage to human life, property, or the environment.

**3.1.538 Hazard Identification** — Determining whether the chemical can cause adverse health effects in humans or damage to property or the environment and what those effects might be.

**3.1.539 Hazard Identification Plan (HIP)** — A thorough, qualitative review of potential hazards for construction work activities that should include a list of all hazards, their assessment (considering severity and probability), and corrective actions to mitigate or prevent worker injuries or illness, and is prepared prior to work activities.

**3.1.540 Hazard Index** — Sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways. Calculated separately for chronic, sub chronic and shorter duration exposures.

**3.1.541 Hazard Point** — The closest reachable point of the hazardous area.

**3.1.542 Hazard Recognition** — The act or process of identifying, recognizing or condition of being recognized, the probability of being injured or harmed and its acceptance or acknowledgment.

**3.1.543 Hazard Sign** — A sign with symbols or wording to indicate a risk to individuals. The arrangement and colors of signs that concern hazards are defined by American National Standards Institute (ANSI) Z 535.2 and Z 535.3 to ensure consistency and understanding by society. *see also* Hazard Symbols.

**3.1.544 Hazard Symbols** — Easily recognizable icons designed to warn about hazardous materials or locations. The use of hazard symbols is usually regulated by law and directed by standards organizations. Hazard symbols may appear with different colors, backgrounds, borders, and supplemental information in order to signify the type of hazard.

**3.1.545 Hazard Prevention and Control** — Hazard prevention and control applies the following measures.

**3.1.545.1** Engineering techniques are used when feasible and appropriate;

**3.1.545.2** Procedures for safe work are established, understood, and followed by all affected parties and;

**3.1.545.3** Provisions are made for personal protective equipment and administrative controls.

**3.1.546 Hazard Quotient** — Ratio of a single substance exposure level over a specified period to a reference dose (RFD) for that substance derived from a similar exposure period.

**3.1.547 Hazard Rate** — Also known as the Time-Related equipment Failure Rate, is an Instantaneous Failure Rate function of time.

**3.1.548 Hazard Ratio** — A number obtained by dividing the airborne concentration of a contaminant by its exposure limit.

**3.1.549 Hazardous Area** — An area that poses an immediate or impending physical hazard.

**3.1.550 Hazardous Atmosphere** — An atmosphere that, by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

**3.1.551 Hazardous Chemical** — Any chemical which is a physical hazard or a health hazard.

**3.1.552 Hazardous Chemical Reactivity** — Property of a chemical substance that can react yielding increases in temperature and/or pressure too large to be absorbed by the environment surrounding the system.

**3.1.553 Hazardous Condition** — The physical condition or circumstance that is causally related to incident occurrence. The hazardous condition is related directly to both the incident type and the agency of the incident.

**3.1.554 Hazardous Decomposition Products** — Formed when a material decomposes (breaks down)

because it is unstable, or reacts with materials such as water or oxygen in air.

**3.1.555 Hazardous Liquid** — A hazardous liquid is a liquid that is dangerous to human health or safety or the environment if used incorrectly or if not properly stored or contained.

**3.1.556 Hazardous Material (HAZMAT) Response Team** — An organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident.

**3.1.557 Hazardous Material** — In a broad sense, any substance or mixture of substances having properties capable of producing adverse effects on the health or safety of human beings. Material presenting dangers beyond the fire problems relating to flash point and boiling point. These dangers may arise from but are not limited to toxicity, reactivity, instability, or corrosivity.

**3.1.558 Hazardous Polymerization** — Polymerization is a process of forming a polymer by combining large numbers of chemical units or monomers into long chains (polyethylene from ethylene or polystyrene from styrene). Uncontrolled polymerization can be extremely hazardous. Some polymerization processes can release considerable heat or can be explosive.

**3.1.559 Hazardous Substance** — Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. It may also refer to any substance designated by the Environmental Protection Agency (EPA) to be reported if a designated quantity of the substance is spilled in the waters of the United States or is otherwise released into the environment.

**3.1.560 Hazardous Waste** — As defined under the Resource Conservation and Recovery Act (RCRA), any solid or combination of solid wastes that, because of its physical, chemical, or infectious characteristics, may pose a hazard when improperly disposed of. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special Environmental Protection Agency (EPA) lists.

**3.1.561 Hazardous Waste Coordinator** — The person who has the responsibility for training laboratory or workplace personnel to deal with the most probable incidents, such as the plugging of a leak in a large container, clean-up of spillage, or transfer of a liquid from one container to another.

**3.1.562 Hazardous Waste Plan** — A document which sets out all aspects of safe waste collection and disposal, and anticipates a variety of high risk situations (such as leaking drum, flash fire, or splashing of a chemical) based on a knowledge of the type of waste. The document should specify an appropriate range of equipment, protective clothing, respiratory protection, and absorbent material to be available, so as to deal with such situations.

**3.1.563 Haz Mat Foam** — A special vapor suppressing mix that can be applied to liquids or solids to prevent off-gassing.

**3.1.564 Hazmat Incident** — Actual or potential unplanned release of a hazardous material.

**3.1.565 HAZOP** — Hazard and Operability Study: A systematic qualitative technique to identify and evaluate process hazards and potential operating problems using a series of guidewords to examine deviations from normal process conditions.

**3.1.566 Hazard Scenario Identification** — The process whereby possible malfunctions are reviewed to permit the identification of realistic hazard scenarios. These can then be modelled.

**3.1.567 Hazard Warning Structure** — A modified form of fault tree highlighting event mitigating feature pairs. These are often pairings of incident precursors and protective devices or event terminating features which are combined through and and gate.

**3.1.568 Health Hazard** — A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.

**3.1.569 Heat** — Energy transferred by a thermal process.

**3.1.570 Heat Balance** — A statement that shows the changes in a system from heat and work input to output losses.

**3.1.571 Heat Capacity** — The amount of heat necessary to raise the temperature of a given mass 1 degree; numerically, the mass multiplied by the specific heat.

**3.1.572 Heat Pyrexia (Heat Stroke)** — A very serious and often fatal condition resulting from breakdown of thermo regulatory mechanisms during exposure to high temperature environments. It is characterized by extremely high deep-body temperature and an absence of sweating. Treatment consists of rapid cooling in an ice bath.

**3.1.573 Heat of Reaction** — The total quantity of thermal energy liberated or absorbed during a chemical reaction.

**3.1.574 Heat Stress**

**3.1.574.1** The external heat load placed on the body due to the characteristics of environment

**3.1.574.2** The burden, or load of heat, that must be dissipated if the body is to remain in thermal equilibrium.

**3.1.575 Heat Stress Index (HSI)** — A composite mixture used for the quantitative assessment of heat stress.

**3.1.576 Hematopoietic Agent** — Chemical which interferes with the blood system by decreasing the oxygen-carrying ability of hemoglobin. This can lead to cyanosis and unconsciousness. Carbon monoxide is one such agent, familiar to smokers.

**3.1.577 Hepatoxin** — A chemical that is injurious to liver.

**3.1.578 Herbicide** — The descriptor applied to a chemical used to kill plants.

**3.1.579 Hidden Hazard** — Typically refers to unseen electrical lines, gas lines, waste lines, water lines, or other lines that, if disturbed during an excavation, may injure personnel or damage equipment.

**3.1.580 High Efficiency Scrubbers** — The use of baffles to alter the flow of a gas or vapor to facilitate its purification by condensation, washing, etc.

**3.1.581 High Integrity Protective Systems (HIPS)** — High availability, fail-safe, safety integrity level (SIL)-3 emergency shutdown (ESD) systems, designed to augment safety relief devices or mitigate worst-case relieving loads, or that function in lieu of over-pressure protective devices in wellhead, flare, or off-site pipelines. *see also* Emergency Shutdown System (ESD); Safety Integrity Level (SIL).

**3.1.582 Highly Protected Risk (HPR)** — Term used within the insurance industry to describe a property risk that has a high degree of care taken for safety and protection (e.g., provision of fire sprinklers in a building) and is considered a superior facility from a loss viewpoint (i.e., low probability of loss); therefore, it has a very low insurance rate compared to other industrial risks.

**3.1.583 High Order Explosion** — Materials that require moderate heat and reducing agents to initiate combustion.

**3.1.584 High Performance Liquid Chromatography (HPLC)** — Laboratory method used to separate organic molecules using a liquid phase.

**3.1.585 Historical Incident Data** — Data collected and recorded from past incidents.

**3.1.586 Hot Zone** — The area immediately around the incident site. Appropriate protective clothing and equipment must be worn by all personnel in the hot zone. Awareness level and operational level trained personnel are not permitted in the Hot Zone.

**3.1.587 Hot Flame Ignition** — A rapid, self sustaining, sometimes audible gas-phase reaction of the sample or its decomposition products with an oxidant. A readily visible yellow or blue flame usually accompanies the reaction (NFPA 325M, 1994).

**3.1.588 Human Error** — Actions by designers, operators, or managers that may contribute to or result in accidents.

**3.1.589 Human Error Probability** — The ratio between the number of human errors and the number of opportunities for human error.

**3.1.590 Human Factors** — A discipline concerned with designing machines, operations, and work environments so that they match human capacities and limitations.

**3.1.591 Human Health Risk** — The likelihood that a given exposure or series of exposures may have damaged or will damage the health of individuals.

**3.1.592 Human Reliability Analysis (HRA)** — A method by which the probability of a person successfully performing a task is estimated.

**3.1.593 Hydration** — The incorporation of molecular water into a complex molecule with the molecules or units of another species. The complex may be held together by relatively weak forces or may exist as a definite compound.

**3.1.594 Hydrocarbons** — The basic building blocks of all organic chemicals which are composed solely of carbon and hydrogen.

**3.1.595 Hygrometer** — An instrument to measure humidity in the atmosphere.

**3.1.596 Hygroscopic** — Readily absorbing or retaining moisture.

**3.1.597 Hygroscopicity** — The tendency to absorb water vapor.

**3.1.598 Hypergolic** — Hypergolic behavior is characterized by immediate, spontaneous ignition of an oxidation reaction upon mixing of two or more substances.

**3.1.599 Hypersensitive** — The condition of being reactive to substances that normally would not affect most people.

**3.1.600 Hyperthermia** — An elevated body temperature due to failed thermoregulation. It is usually defined as a temperature greater than 37.5 °C to 38.3 °C (100 °F to 101 °F). Hyperthermia occurs when the body produces or absorbs more heat than it can dissipate. When the elevated body temperatures are sufficiently high, hyperthermia is a medical emergency and requires immediate treatment to prevent disability and death.

**3.1.601 Hypothermia** — Lowered core body temperature, usually considered a drop in core temperature to 35 °C (95 °F) or lower. It produces shivering and discomfort sufficient to adversely affect performance; at about 25 °C (77 °F) hypothermia is ordinarily fatal. Cold water immersion produces hypothermia very rapidly, whereas exposure in cold air environments is tolerable for much longer periods. Treatment for hypothermia is rapid re-warming in a warm bath.

## I

**3.1.602 Ignition Temperature** — The minimum temperature to which a material must be raised before it will burn. The ignition temperature is higher than the flashpoint.

**3.1.603 Immediate Hazard** — The potential to cause an adverse effect within a short period of time.

**3.1.604 Immediate Severe Health Effect** — Acute clinical sign of a serious, exposure-related reaction that occurs within 72 h.

**3.1.605 Immediately Dangerous to Life or Health (IDLH)** — An atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

**3.1.606 Imminent Danger** — An impending or threatening dangerous situation that could be expected to cause death or serious injury to persons in the immediate future unless corrective measures are taken.

**3.1.607 Imminent Hazard** — A hazard that would likely result in unreasonable adverse effects on humans or the environment or risk unreasonable hazard to an



endangered species during the time required for a pesticide registration cancellation proceeding.

**3.1.608 *Impeller*** — The rotating part of a device (fan, blower, compressor or pump).

**3.1.609 *Impervious*** — Incapable of being passed through or penetrated.

**3.1.610 *Impact*** — To impact, hit, strike, collide, or push against.

**3.1.611 *Impingers*** — Small glass bottles normally filled with a specific liquid that will absorb air borne chemicals when air containing the contaminant is bubbled through it.

**3.1.612 *Implosion*** — The catastrophic collapse of the walls of a closed container due to excessive external pressure in comparison with the internal pressure.

**3.1.613 *Impurity*** — The presence of one substance in another, often in such low concentration that it cannot be measured quantitatively by ordinary analytical methods. In the air, trace amounts of sulfur dioxide and carbon monoxide are potentially dangerous impurities in concentrations of 5 ppm of sulfur dioxide and 50 ppm of carbon monoxide.

**3.1.614 *Incendiary*** — A substance causing or designed to cause fires. Also, a person who willfully destroys property by fire.

**3.1.615 *Impulse*** — The area under the overpressure-time curve for explosions. The area can be calculated for the positive phase or negative phase of the blast.

**3.1.616 *Incident*** — An unplanned event or series of events and circumstances that may result in an undesirable consequence.

**3.1.617 *Incident Investigation*** — The management process by which underlying causes of undesirable events are uncovered and steps are taken to prevent similar occurrences.

**3.1.618 *Incident Investigation Team*** — A group of qualified people that examine an incident in a manner that is timely, objective, systematic and technically sound to determine that factual information pertaining to the event is documented, probable causes are ascertained, and complete technical understanding of such an event is achieved.

**3.1.619 *Incompatible*** — The term can refer to any undesired results occurring when substances are combined. In the context of this publication, it refers to incompatible substances giving an undesired chemical reaction when combined, posing a chemical reactivity hazard under a defined scenario.

**3.1.620 *Incompatible Chemicals*** — Two or more chemicals which can react with each other violently, with evolution of substantial heat, so as to produce flammable or toxic products.

**3.1.621 *Incompatible wastes*** — Two or more chemical wastes, the mixing of which can result in the slow or explosive release of toxic gases, vapors or fumes. This may occur spontaneously at ambient temperature and pressure, or if the mixture is exposed to water, subjected to strong force, or heated under confined conditions.

**3.1.622 *Incident*** — The loss of containment of material or energy.

**3.1.623 *Incident Enumeration*** — The identification and tabulation of incidents without regard to significance or other bases.

**3.1.624 *Incident Outcome*** — The physical manifestation of an incident.

**3.1.625 *Incident Outcome Case*** — The quantitative definition of a single result of an incident outcome through specification of sufficient parameters to allow distinction of this case from all others for the same incident outcome.

**3.1.626 *Incineration*** — The controlled combustion of waste so as to prevent explosion or the unacceptable release of harmful products.

**3.1.627 *Indicating Layer*** — The calorimetric reactive portion of the detector tube.

**3.1.628 *Indicating Molecular Sieve*** — A molecular sieve that indicates by a color change when the capacity for water absorption in drying a gas or vapor has been exceeded.

**3.1.629 *Independent Protection Layer (IPL)*** — Protection measures that reduce the level of risk or a serious event by 100 times, have a high degree of availability (greater than 0.99), or have specificity, independence, dependability, and auditability.

**3.1.630 *Indirect Damage*** — Loss resulting from a hazardous condition or incident but not caused directly thereby.

**3.1.631 *Individual Hazard Index (IHI)*** — The Fatal Accident Rate (FAR) for a particular hazard, with the exposure time defined as the actual time that a person is exposed to a hazard of concern.

**3.1.632 *Individual Risk*** — The risk to a person in the vicinity of a hazard. This includes the nature of the injury to the individual, the likelihood of the injury occurring, and the time period over which the injury might occur.

**3.1.633 Industrial Waste** — Unwanted materials produced in or eliminated from an industrial operation and categorized under a variety of headings, such as liquid wastes, sludge, solid wastes, and hazardous wastes.

**3.1.634 Inert Chemical** — Not having active properties.

**3.1.635 Inert Dust** — Dust that does not chemically react with other substances.

**3.1.636 Inert Gas** — A gas that neither experiences nor causes chemical reaction, nor undergoes a change of state in a system or process.

**3.1.637 Inflammable** — A general term once used to describe combustible gases, liquids, or solids.

**3.1.638 Initial List (of Incidents)** — A list containing all the incidents identified by the enumeration methods chosen.

**3.1.639 Initiator** — The substance or molecule (other than reactant) that initiates a chain reaction, as in polymerization.

**3.1.640 Initiating Event** — The first event in an event sequence.

**3.1.641 Inhalation** — Breathing a chemical into the lung.

**3.1.642 Inhibited** — Containing a small amount of another substance included to prevent the first material from reacting with itself or other things in its environment.

**3.1.643 Insecticide** — A chemical used to kill insects.

**3.1.644 Insoluble** — Not able to be dissolved.

**3.1.645 Instantaneous Release** — Emissions that are short in duration compared with the travel time (time for cloud to reach location of interest) or sampling (or averaging) time.

**3.1.646 Intermediate Event** — An event that propagates or mitigates the initiating event during an event sequence.

**3.1.647 Inhibitor** — A chemical substance used to prevent or stop a chemical reaction, such as polymerization, from occurring.

**3.1.648 Instability** — The degree of intrinsic susceptibility of a material to release energy through self-reaction (polymerizing, decomposing or rearranging).

**3.1.649 Inert Gas** — A noncombustible, nonreactive gas that renders the combustible material in a system capable of supporting combustion.

**3.1.750 Inherently Safe** — A system is inherently safe if it remains in a nonhazardous situation after the occurrence of non-acceptable deviations from normal operating conditions.

**3.1.751 Injury** — Physical harm or damage to a person resulting from traumatic contact between the body and an outside agency or exposure to environmental factors.

**3.1.752 Inlet Size** — The nominal pipe size of the inlet of a pressure relief valve, unless otherwise designated.

**3.1.753 Inorganic** — Term used to designate compounds that generally do not contain carbon.

**3.1.754 Interlock System** — A system that detects out-of-limits or abnormal conditions or improper sequences and either halts further action or starts corrective action.

**3.1.755 Intrinsically Safe** — Equipment and wiring which is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture or hazardous layer.

**3.1.756 Integrated Sampling** — The passage of a known volume of air through an absorbing or adsorbing medium to remove the desired contaminants from the air during a specified period.

**3.1.757 Intentional Chemistry** — Processing of substances such that a chemical reaction takes place as intended.

**3.1.758 Interference** — The term applied when a contaminant, other than the target gas or vapor, reacts with a reagent in the detector tube to produce erroneous results.

**3.1.759 Inter-laboratory Quality Control (QC)** — A systematic procedure for selecting inter laboratory participants, analyte, duration and frequency of inter laboratory testing, and evaluating statistics and reporting of test data to ensure the quality of test result

**3.1.760 Internal Occupational Exposure Limit** — An occupational exposure limit (OEL) formally set by an organization for its private use.

**3.1.761 Intra-laboratory Quality Control (QC)** — A systematic procedure for evaluating the precision and accuracy for within analyst and between analyst data constructing and using control charts, and using duplicate, replicate, and/or spiked samples to ensure the quality of test results.

**3.1.762 Intrinsic Safety** — Plants that are designed so that departures from normal tend to be self-correcting or at most lead to minor events rather than major disasters. Plants designed to be forgiving and self-correcting are inherently safer than plans where

equipment has been added to control hazards or where operators are expected to control them.

**3.1.763 *Intrinsically Safe*** — A feature available on air sampling equipment that ensures that pumps are not an explosive hazard in specific environments.

**3.1.764 *Intrinsic Property*** — In relation to materials, a property of the material itself, regardless of use or environmental conditions.

**3.1.765 *Ion Chromatography(IC)*** — A chromatographic technique that separates mixture of ions.

**3.1.766 *Ionization Potential*** — The energy per unit charge needed to remove an electron from a given kind of atom or molecule to an infinite distance, usually expressed in volts. Also known as ion potential.

**3.1.767 *Irritant*** — A chemical, which is not corrosive, that causes a reversible inflammatory effect on living tissue by the chemical action at the site of contact.

**3.1.768 *Isenthalpic Expansion*** — A reduction in pressure that occurs with no change in enthalpy of the system, which implies negligible change in kinetic energy effects, and no work or exchange of heat with the surroundings. This condition is approached in throttling processes or flow through piping, where friction effects usually occur, but where heat transfer with the surroundings and changes in kinetic energy can be neglected.

**3.1.769 *Isentropic Expansion*** — A pressure reduction that occurs reversibly, with no friction, work, or exchange of heat with the surroundings. This condition is approached in flow of compressible gases through a smooth, well-rounded nozzle.

**3.1.770 *Isomer*** — A material with the same chemical composition (i.e. kind and number of elements) as another material but with a different arrangement of those elements. For example, n-butyl alcohol and t-butyl alcohol are isomers of one another.

**3.1.771 *Isomerization*** — The conversion of a chemical with a given molecular formula to another compound with the same molecular formula but a different molecular structure, such as from a straight chain to a branched-chain hydrocarbon or an alicyclic to an aromatic hydrocarbon. Examples include the isomerization of ethylene oxide to acetaldehyde (both  $C_2H_4O$ ) and butane to isobutene (both  $C_4H_{10}$ ).

**3.1.772 *Isothermal*** — A system condition in which the temperature remains constant. This implies that temperature increases and decreases are compensated by sufficient heat exchange with the environment of the system.

### 3.1.773 *Isotope*

**3.1.773.1** Two or more nuclides with the same atomic number but different atomic mass.

**3.1.773.2** Atoms of the same element that differ in atomic weight.

**3.1.774 *Isoperibolic System*** — A system in which the controlling external temperature is kept constant.

**3.1.775 *Isopleth*** — A line of constant vapor concentration downwind from a release.

**3.1.776 *Iterative Risk Assessment*** — A process in which increasingly complex and data-rich risk assessments are conducted.

## J

**3.1.777 *Jet Discharge*** — A pressurized discharge of liquid, vapor, and/or gas into free space from an orifice, the momentum of which induces the surrounding atmosphere to mix with the discharged material.

**3.1.778 *Jet Fire*** — Fire type resulting from ignition of a jet discharge.

**3.1.779 *Job safety analysis (JSA)*** — A safety management risk assessment technique that is used to define and control the hazards associated with a process, job or procedure. The job safety analysis ensures that the hazards involved in each step of a task are reduced to as low as reasonably practical (ALARP). The assessment starts with a summary of the entire job process. The job is broken into smaller steps and listed in a tabular form. The hazards for each step are then identified and listed. This is repeated for each step in the process and a method of safe work is identified. It may be also called a job hazard analysis (JHA).

**3.1.780 *Job Safety Training*** — Training associated with or emphasizing the safety aspects of a job and the hazards of tasks and their interrelationships within a job.

## K

**3.1.781 *Kawamura and Mackay Model*** — A model used to represent pool evaporation.

**3.1.782 *Key Event (of an Accident)*** — That event (or events) in a series of events in an incident that determine the exact time, place, type, and extent of consequences of the incident.

**3.1.783 *Kinetic Data*** — data that describe the rate of change of concentrations, heat, pressure, volume, etc. in a reacting system.

**3.1.784 *Kinetic Energy***—Energy due to motion

**3.1.785** *Kinetic Tree Theory (KIT)* — An approximation method that allows the analyst to estimate fault tree Top Event reliability characteristics through use of minimal cut sets, and failure data for the basic events in the fault tree.

## L

**3.1.786** *Labeled* — Equipment or materials to which is attached a specified label, symbol, or other identifying mark of an inspection agency, nationally recognized testing laboratory, or organization acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of the production of labeled equipment or materials. The provision of a label by the manufacturer on a fire protection product indicates compliance with appropriate standards or performance in a specified manner for fire safety.

**3.1.787** *Lachrymator* — A chemical that irritates the mucous membranes of the eye or nose that causes secretions. (tears, or a running nose).

**3.1.788** *Lagging* — Asbestos and magnesia plaster that is used as a thermal insulation on process equipment and piping.

**3.1.789** *Latency* — A delay between the onset of exposure to a hazardous agent and the onset of illness attributable to that agent.

**3.1.790** *Latency Period* — The time that elapses between exposure and the first manifestation of damage.

**3.1.791** *Level of Concern* — The concentration of an airborne chemical above which there may be adverse human health effects experienced as a result of a short-term exposure during an episodic release.

**3.1.792** *Likelihood* — A measure of the expected probability or frequency of occurrence of an event.

**3.1.793** *Limit of Detection (LOD)* — A stated limiting value designating the lowest concentration that can be detected and that is specific to the analytical procedure used.

**3.1.794** *Limit of Quantification (LOQ)* — A stated limiting value designating the lowest concentration that can be quantified with confidence and that is specific to the analytical procedure used.

**3.1.795** *Liquid Trim Valve* — A safety relief valve designed for incompressible fluid service, typically with adjustable blowdown. The valve can be certified for use with compressible fluids.

**3.1.796** *Localized Incident* — An incident whose effect zone is limited to a plant area (e.g., pump fire, small toxic release), and does not extend into the off-site surrounding community.

**3.1.797** *Local Exhaust Ventilation (LEV)* — An industrial ventilation system that captures and removes emitted contaminants before dilution into the workplace ambient air can occur.

**3.1.798** *Logic Gate* — A symbol in a logic diagram which specifies the logical combination of inputs required for an output to be propagated.

**3.1.799** *Loop Reactors* — Continuous flow reactors in which all or part of the product stream is recirculated to the reactor, either directly or mixed with a reactant supply stream.

**3.1.800** *Lower Boundary of Working Range* — Refers to the contaminant concentration that may be quantified at a specific air volume when the mass of contaminant is equal to the LOQ.

**3.1.801** *Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL)* — The lowest concentration of a vapor or gas (the lowest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. *see also* Upper Explosive Limit or Upper Flammable Limit. *Importance:* At concentration lower than the LEL/LFL, the mixture is too –lean to burn.

**3.1.802** *Low Order Explosion* — Materials that require excessive heat and reducing agents to initiate combustion.

**3.1.803** *Low Pressure Container* — A container designed to withstand pressures from 5 psi to 100 psi.

## M

**3.1.804** *Malformation* — Defective or abnormal formation.

**3.1.805** *Malodorous substance* — A substance that has an unpleasant smell.

**3.1.806** *Management of Hazardous Waste* — The implied control and environmentally sound handling of hazardous waste during the phases of generation, storage, processing for recovery or reuse, transporting, treating and discharging into the air and water or discarding onto the soil.

**3.1.807** *Manifold* — A holder for more than one detector tube. When attached to the sampling pump, it permits simultaneous sampling.

**3.1.808 Manometer** — An instrument for measuring pressure, essentially a U-tube partially filled with a liquid (usually water, mercury or a light oil), so constructed that the amount of displacement of the liquid indicates the pressure being exerted on the instrument.

**3.1.809 Manual Pull Station (MPS), Fire Alarm** — A switch provided on a fire alarm system that is manually activated to indicate a fire event. The switch is configured to conspicuously identify it as a fire alarm device and is usually fitted with a tamper device (break glass, rod, or cover) to discourage or prevent false activation. It sends a signal to a central monitoring station for notification of location and activation of alarms.

**3.1.810 Margin of Safety** — A border, edge, or limit beyond which a particular behavior, condition, or situation becomes hazardous or unsafe.

**3.1.811 Material Safety Data Sheet (MSDS)** — A document containing information on hazardous ingredients, their properties, and precautions for use for a specific chemical substance.

**3.1.812 Mask** — A protective covering for the face or head, such as a wire screen, a metal shield, a respirator, or a gas mask.

**3.1.813 Mass Number** — The number of nucleons (protons and neutrons) in the nucleus of an atom.

**3.1.814 Maximum Allowable Concentration** — The maximum concentration in air of a material that may be toxic or hazardous to health that the facility and the public authorities having jurisdiction are willing to tolerate at a populated downwind location in the event of a major accident.

**3.1.815 Maximum Allowable Venting (or Relieving) Pressure** — The pressure corresponding to the Code allowable pressure rise (accumulation) over the maximum allowable working pressure (MAWP) under relieving conditions.

**3.1.816 Maximum Allowable Working Pressure** — The maximum gauge pressure permissible at the top of a completed vessel in its operating position for a designated temperature. The pressure is based on calculations for each element in a vessel using nominal thickness, exclusive of additional metal thickness allowed for corrosion and loadings other than pressure. The maximum allowable working pressure is the basis for the pressure setting of the pressure relief devices that protect the vessel.

NOTE — In general MAWP is the basis for the maximum permissible settings of the relief devices.

**3.1.817 Major Incident** — An incident whose effect zone, while significant, is still limited to site boundaries (for example, major fire, spill).

**3.1.818 Maximum Individual Risk** — The individual risk to the person(s) exposed to the highest risk in an exposed population.

**3.1.819 Maximum Potential Quantity** — The maximum amount of a chemical that can be released from a process containment system. Such a system may be an isolated pressure vessel and associated piping or two or more interconnected and communicating vessels without isolation capability.

**3.1.820 Maximum Pressure after Decomposition** — The maximum pressure obtainable in a closed vessel; this pressure is a function of the adiabatic temperature rise and the specific gas production.

**3.1.821 Mean Free Path** — The average distance travelled between collisions by the molecules in a gas or vapor.

**3.1.822 Mean Time between Failure (MTBF)** — A basic measure of "reliability" for repairable items. The mean operating time or number of demands during which all parts of the item performed within their specific limits, during a particular measurement interval, under stated conditions (1/Failure Rate).

**3.1.823 Melting point (MP)** — For a given pressure, the temperature at which the solid and liquid phases of the substance are in equilibrium.

**3.1.824 Metabolic Transformation** — The chemical transformation of substances that takes place within an organism.

**3.1.825 Metabolism** — In general, the sum total of all physical and chemical processes that take place within an organism; in a narrower sense, the physical and chemical changes that take place in a given chemical substance within an organism. It includes the uptake and distribution within the body of chemical compounds, the changes (biotransformation) undergone by such substances, and the elimination of the compounds and of their metabolites.

**3.1.826 Metabolite** — A substance resulting from chemical transformation in an organism.

**3.1.827 Metal Fume Fever** — A flu-like condition that is caused as a result of inhaling heated metal fumes.

**3.1.828 Metallic Oxide Semiconductor (MOS) Sensor** — A solid state sensor used to detect ppm and combustible concentrations of gases. It can be used to

detect a variety of compounds including nitro, amine, alcohol, and halogenated hydrocarbons, as well as a limited number of inorganic gases.

**3.1.829 Methaemoglobinaemia** — The presence of methaemoglobin in the blood due to the exposure to a chemical that gives rise to oxidation of haemoglobin.

**3.1.830 Microcalorimetry** — Essentially isothermal techniques of high sensitivity in which very small heat fluxes from the reacting materials are measured; differential microcalorimetry is a technique to determine heat fluxes from the reacting materials compared with those of a reference material.

**3.1.831 Minimal Cut Set Approach** — A term used in Fault Tree Analysis to describe the smallest combination of component and human failures which, if they all occur, will cause the top event to occur. The failures all correspond to Basic or Undeveloped Events.

**3.1.832 Misuse Mode and Effects Analysis (MMEA)** — Assesses the likelihood of occurrence of potential misuse modes and their effect on safety before and after corrective actions.

**3.1.833 Mitigation Factors** — Systems or procedures, such as water sprays, foam systems, and sheltering and evacuations, which tend to reduce the magnitude of potential effects due to a release.

**3.1.834 Mixture** — Any combination of two or more chemicals if the combination is not, whole or part, the result of a chemical reaction.

**3.1.835 Minimum Ignition Energy (MIE)** — Electrical energy discharged from a capacitor, which is just sufficient to effect ignition of the most ignitable mixture of a given fuel-mixture under specific test conditions.

**3.1.836 Monomer** — A simple molecule that is capable of combining with a number of other molecules to form a polymer.

**3.1.837 Moral (Ethical) Safety** — The ability to maintain a set of standards, beliefs, and operating principles that are consistent, that guide behavior, and that are grounded in a respect for life.

**3.1.838 Minimum Required Relief Capacity** — Relieving capacity required to prevent the pressure in the protected vessel from exceeding the maximum allowable working pressure by more than allowed by the ASME BPVC or other applicable codes or practices.

**3.1.839 Mitigation** — Lessening the risk of an accident event sequence by acting on the source in a preventive way by reducing the likelihood of occurrence of the event, or in a protective way by reducing the magnitude of the event and /or the exposure of local persons or property.

**3.1.840 Mismanagement of Hazardous Waste** — The uncontrolled and environmentally unsound or indiscriminate handling of hazardous wastes, whether intentionally or unintentionally.

**3.1.841 Miscible** — Susceptible to being mixed; soluble in all proportions.

**3.1.842 Mixing box** — A compartment in which two air supplies mix before being discharged.

**3.1.843 Molecule** — Generally the smallest particle of an element or a compound capable of retaining the physical properties and chemical identity of the substance in mass.

**3.1.844 Molluscicide** — A chemical used to kill molluscs.

**3.1.845 Moment of Inertia** — The measure of resistance to rotational change.

**3.1.846 Monitoring Instruments** — A broad range of scientific equipment used for the purposes of collecting and/or measuring chemical levels.

**3.1.847 Monitoring of Airborne Concentrations** — A chemical technique used in occupational health surveillance to measure a variety of different toxic materials in workplace or ambient air.

**3.1.848 Monodisperse** — Composed of particles with a single size or small range of sizes.

**3.1.849 Monodisperse Aerosol** — An aerosol with a uniform size distribution having a geometric standard deviation of less than 1.1.

**3.1.850 Morphological Approach** — A structured analysis of an incident directed by insights from historic case studies but not as rigorous as a formal hazard analysis.

**3.1.851 Mortality Index** — An index based on the observed average ratio of casualties to the mass of material or energy released, as derived from the historical record. It is used to characterize the potential hazard of toxic material storage.

**3.1.852 Multi-gas Detector** — An air monitoring device that measures oxygen levels, explosive (flammable) levels, and one or two toxic gases such as carbon monoxide or hydrogen sulfide.

**3.1.853 Multi-layer Detector Tube** — A detector tube construction containing several filling layers. In addition to the indicating layer the tube contains one or more prelayers, which act as a filter to remove interfering substances or for chemical conversion of the gas or vapor being measured. Such tubes may be used to determine qualitatively the classes of compounds present in the atmosphere sampled.

**3.1.854 Multiple Chemical Sensitivity (MCS)** — A condition resulting from exposure to toxic chemicals that affect the immune system, leading to multiple sensitivities to other chemicals and/or foods. Symptoms of MCS, which may be similar to those of sick building syndrome (SBS), are often attributed to exposure to trace amounts of chemicals (especially those with perceptible odor) in indoor air.

**3.1.855 Multiple Particle Optical Monitor** — A real-time dust monitor used to measure aerosol concentrations.

**3.1.856 Multistage Sampling** — A type of sampling in which the sample is selected by stages, the sampling units at each stage being sub sampled from the larger units chosen at the previous state.

**3.1.857 Mutagenicity** — The property of a physical, chemical, or biological agent to induce mutations in living tissue.

**3.1.858 Mutation** — Any heritable change in genetic material. This may be a chemical transformation of an individual gene (a gene or point mutation), which alters its function. On the other hand, this change may involve a rearrangement, or a gain or loss of part of a chromosome, which may be microscopically visible. This is designated a chromosomal mutation.

## N

**3.1.859 Narcosis** — Stupor or unconsciousness produced by chemical substances.

**3.1.860 Negatively Buoyant Gas** — A gas with density greater than that of air at ambient temperature.

**3.1.861 Negative-Pressure Glove Box** — A glove box that is maintained and used at a lower pressure than atmospheric to ensure that there is no loss of material inside it to the laboratory.

**3.1.862 Nematicide** — A chemical used to kill nematodes.

**3.1.863 Nephrotoxin** — A chemical which may cause kidney damage. Common examples include antimony compounds, dimethyl sulphoxide, dimethylformamide and tetrahydrofuran.

**3.1.864 Neurotoxin** — Chemical whose primary action is on the CNS (Central Nervous System). Many neurotoxins, such as some mercury compounds, are highly toxic, and must only be used under carefully controlled conditions.

**3.1.865 Neutralization** — Control strategy for hazardous substances (e.g., strong acids, caustics, oxidizers, etc.) whereby a neutralizing compound is

added to a highly dangerous compound, e.g., an acid to an alkali, to reduce its immediate danger.

**3.1.866 Neutral Buoyant Gas** — A gas with density approximately equal to that of air at ambient temperature.

**3.1.867 Net Flow Area** — The area which determines the flow after a non reclosing pressure relief device has operated. The (minimum) net flow area of a ruptured disk is the calculated net area after a complete burst of the disk, with appropriate allowance for any structural members which may reduce the net flow area through the rupture disk device.

**3.1.868 Net Positive Suction Head (NPSH)** — Equivalent total head of liquid at the pump center line, less the vapor pressure, required to avoid cavitation in a pump.

**3.1.869 Nitrating Mixture** — Mixture of nitric acid and sulphuric acid with or without varying amounts of water, used in the manufacture of explosives by nitration process.

**3.1.870 Nitrogen Narcosis** — Narcosis caused by gaseous nitrogen at high pressure in the blood. Produced in divers breathing air at depths of 100 ft (30 m) or more.

**3.1.871 Nitrogen-Phosphorus Detector** — The nitrogen-phosphorus detector is highly sensitive and selective for nitrogen and phosphorus compounds, including amines and organophosphates. The detector is similar in principle to the FID, except that ionization occurs on the surface of an alkali metal salt, such as cesium bromide, rhodium silicate, or potassium chloride. (Also known as *thermionic or alkali flame detector*).

**3.1.872 Node** — As identified in a safety review (e.g., process hazard analysis [PHA], What-If Analysis, Hazard and Operability Study [HAZOP]), a defined part (section or subsystem or item of equipment) of a process that has a design intention that is specific and distinct from the design intention of other process parts, which allows the study team to analyze the specific equipment or system in an organized fashion.

**3.1.873 Nominal Hazard Zone** — The NHZ is the zone around the laser where the beam intensity exceeds the exposure limit.

**3.1.874 No – Observed – Adverse-Level (NOEL)** — The greatest concentration or amount of a chemical, found by experiment or observation, that causes no detectable adverse alteration of morphology, functional capacity, growth, development, or life span of the target.

**3.1.875 Non-beam Hazard** — A hazardous agent, other than the beam, generated by the use of lasers (e.g., electricity, airborne contaminants, plasma radiations, fires and explosions).

**3.1.876 Noncarcinogen** — A chemical that exerts adverse health effects other than cancer.

**3.1.877 Noncompliance** — Noncompliance with health and safety regulations.

**3.1.878 Nonflammable** — Not easily ignited, or if ignited, not burning rapidly.

**3.1.879 Nongenotoxic Chemicals** — Toxic substances that do not interact directly with DNA.

**3.1.880 Nonionizing Radiation (NIR)** — Photons with energies less than 12.4 eV are considered to have insufficient energy to ionize matter, and are nonionizing in nature. The nonionizing spectral region includes ultraviolet (UV), visible, infrared (IR), radiofrequency (RF), and extremely low frequency (ELF) region.

**3.1.881 Nonhazardous Waste** — Waste material of sufficiently low toxicity for safe disposal in a sanitary landfill. All such materials have LD<sub>50</sub> of 500 mg/kg or more.

**3.1.882 Noxious** — Harmful to health.

**3.1.883 Noncombustible** — A material or substance that will not burn readily or quickly. Noncombustible implies a lower degree of fire resistance than fire resistive.

**3.1.884 Noncredible Event** — A scenario or event that has very low and unreasonable likelihood of occurrence, and need not be considered in selecting the design basis for an emergency relief system. This should be based on a risk analysis that includes a careful and thorough review of process characteristics, experience with similar systems, hazardous nature of the materials handled, and consequences of an incident.

**3.1.885 Nonreclosing Pressure Relief Device** — A pressure relief device designed to remain open after operation. A manual resetting means may be provided.

**3.1.886 Nozzle** — A pressure containing element of a pressure relief valve which constitutes the smooth inlet flow passage and includes the fixed portion of the seat closure. The downstream end of the nozzle is often termed the valve orifice or nozzle throat.

NOTE — Also can refer to the inlet or outlet connection on a vessel.

## O

**3.1.887 Occluded** — Closed, shut, or blocked.

**3.1.888 Occupational Cancer** — Cancer caused by exposure to chemical or physical agents in the work environment.

**3.1.889 Occupational Disease** — Disease associated with a work environment, usually caused by a specific agent.

**3.1.890 Occupational Exposure Limit (OEL)** — A health-based work-place standard to protect workers from adverse exposure.

**3.1.891 Occupational Hazard** — Conditions that exist in a workplace environment that increase the probability of death, injury, or illness to a worker.

**3.1.892 Occupational Hygiene** — The applied science concerned with recognition, evaluation and control of chemical, physical or biological factors arising from the workplace and which may affect the well-being of those at work or in the community.

**3.1.893 Occupational Incident** — Incident involving injury to workers.

**3.1.894 Occupational Safety** — The prevention of personnel and environmental incidents in work-related environments or situations. Effective occupational safety efforts involve the control and elimination of recognized workplace hazards to attain an acceptable level of risk and promote the wellness of workers. Optimal occupational safety results from a continuous proactive process of anticipating, identifying, designing, implementing, and evaluating risk-reduction practices.

**3.1.895 Occupational Safety and Health Codes and Standards** — Rules of procedure designed to secure uniformity and protection of life and property having the force of law in certain jurisdictions.

**3.1.896 Onset Temperature** — The temperature at which a deflection from the established baseline is first observed.

**3.1.897 Opening Pressure** — The value of increasing inlet static pressure of a pressure relief valve at which there is a measurable lift, or at which the discharge becomes continuous as determined by seeing, feeling, or hearing.



**3.1.898 Open Up Tester** — A device for determining flash points of flammable and combustible liquids, utilizing an open cup, or container of the liquid. Recognized types are the Tagliabue (Tag) Open Cup Apparatus and the Cleveland Open Cup Apparatus.

**3.1.899 Operating Margin** — The difference between the highest pressure attained in normal operation and the set pressure, expressed either in pressure units or as a percentage of the set pressure. Note that the Code term is -pressure differential.

**3.1.900 Optimum Risk** — A risk level that balances the cost of the risk with the cost of risk mitigation.

**3.1.901 Organic** — Term used to designate chemicals that contain carbon. To date nearly 1 million organic compounds have been synthesized or isolated. Many occur in nature; others are produced by chemical synthesis.

**3.1.902 Orifice** — A small opening that controls flow rate of gases or liquids. Orifices are used in some hand-held detector tube pumps.

**3.1.903 Orifice Plate** — A plate with a relatively sharp edged opening or orifice used to measure fluid flow rates based on pressure difference between the two sides of the plate.

**3.1.904 Organic Peroxide** — An organic compound that contains the bivalent  $-O-O-$  structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

**3.1.905 Outlet Size** — The nominal pipe size of the outlet of a pressure relief valve, unless otherwise designated.

**3.1.906 Over Adiabatic Mode** — A quasi-adiabatic mode in which the (small) energy leaks to the environment are overcompensated for by input of supplementary energy.

**3.1.907 Overload** — Operation of equipment in excess of the normal full load rating. If it persists for a sufficient length of time it would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

**3.1.908 Overpressure** — A pressure increase over the set pressure of a pressure relief valve, unless otherwise designated.

**3.1.909 Overrange Limit** — The maximum input that can be applied to a device without causing damage or permanent change in performance.

**3.1.910 Oxidant** — A chemical material that supports the combustion reaction process to combine with a fuel, e.g., oxygen, nitrous oxide, nitric oxide, chlorates, and chlorine.

**3.1.911 Oxidation** — Depending on the context, oxidation can either refer to (a) a reaction in which oxygen combines chemically with another substance or (b) any reaction in which electrons are transferred. For the latter definition, oxidation and reduction always occur simultaneously (redox reactions), and the substance that gains electrons is termed the oxidizing agent. Electrons might also be displaced within a molecule without being completely transferred away from it.

**3.1.912 Oxidizer** — Any material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials. More generally, an oxidizer is any oxidizing agent.

**3.1.913 Oxidizing** — This adjective applied to a chemical is a substance which gives off oxygen to another substance. Oxidizing chemicals may increase and sustain fires. For example, chemicals belonging to following groups may act as oxidizers: bromates, chlorates, chromates, dichromates, iodates, nitrates, oxides, perborate, perbromates, perchlorates, periodates, permanganates and peroxides.

**3.1.914 Oxidizing Agent** — *see* definition for oxidation.

**3.1.915 Oxygen Deficient** — ambient air containing less than 19.5 % oxygen concentration.

**3.1.916 Oxygen Enriched** — ambient air containing above 20 percent oxygen concentration.

**3.1.917 Ozone** — A colorless gas with a characteristic odor that is produced in ambient air during the photochemical oxidation of combustion products such as the nitrogen oxides and hydrocarbons. It can also result from the operation of electrical motors, photocopy machines and electrostatic air cleaners in occupational environments.

**3.1.918 Oxygen Monitor** — A device that measures the percentage of oxygen present in the atmosphere at any point in time. In some instances it is linked to a visual or audible alarm when the level has decreased to a point of concern.

**3.1.919 Oxygen Toxicity** — A disorder associated with increased partial pressures of oxygen. There are two types of oxygen toxicity:

**3.1.919.1 High pressure:** Breathing 100 percent oxygen at pressures greater than 3 ATA (atmospheres absolute) may result in acute toxicity, producing convulsions.

**3.1.919.2** Low pressure: Breathing 100 percent oxygen at 1 ATA for extended periods (24 hours or greater) may result in pulmonary dysfunction and pulmonary edema.

## P

**3.1.920** *Partial Oxidation* — The combination of oxygen with a material in an oxygen-deficient atmosphere that generally results in carbon monoxide being one of the combustion products.

**3.1.921** *Partial pressure* — Pressure of a gas in a mixture equal to the pressure that it would exert if it occupied the same volume alone at the same temperature (see also Dalton's law).

**3.1.922** *Particle* — A small discrete object, often having a density approaching the intrinsic density of the bulk material. It may be chemically homogeneous or contain a variety of chemical species. It may consist of solid or liquid material or both. (see also aerosol)

**3.1.923** *Particle Bounce* — Rebound of particles that fail to adhere after impacting on a collecting surface.

**3.1.924** *Particle Diffusivity ( $D_B$ )* — Aerosol particles in a gaseous medium are bombarded by collisions with individual gas molecules that are in Brownian motion. This causes the particles to undergo random displacements known as diffusion. The particle parameter that describes this process is the particle diffusivity,  $D_B$  (Also known as — diffusion coefficient.)

**3.1.925** *Particle Size Distribution* — A relationship expressing the quantity of a particle property associated with particles in a given size range.

**3.1.926** *Particulate* — Particle of solid or liquid matter.

**3.1.927** *Particulate Matter (PM)* — A suspension of fine solid or liquid particles in air, such as dust, fog, fume, mist, smoke, or sprays. Particulate matter suspended in air is commonly known as an aerosol.

**3.1.928** *Partition Coefficient* — The constant ratio that is found when a heterogeneous system of two phases is in equilibrium; the ratio of the concentrations of the same molecular species (substance) in two phases (usually water and octanol) is constant at given temperature and pressure.

**3.1.929** *Passive dosimeter* — A sample collection device based on the mass transport of the air contaminant to the sorbent by gaseous diffusion. It can incorporate direct-reading colorimetry to determine the concentration of the chemical in the air.

**3.1.930** *Passive sampling* — The collection of airborne gases and vapors at a rate controlled by a physical process such as diffusion through a static air layer or

permeation through a membrane without the active movement of air through an air sampler.

**3.1.931** *Pathway* — The course a chemical or pollutant takes from the source to the organism exposed.

**3.1.932** *Penetration* — The flow of chemical through zippers, weak seams, pinholes, cuts or imperfections in the protective clothing on a nonmolecular level.

**3.1.933** *Perceived risk* — The risk that the individual believes exists.

**3.1.934** *Permeation* — The movement of a chemical through a protective clothing barrier that has no visible holes.

**3.1.935** *Periodicity* — The frequency at which tests are given.

**3.1.936** *Permeation Method* — A method for preparing a known mixture of a low concentration gas for verification testing of detector tubes. Gas permeates the walls of a gas permeable vessel (permeation tube) into the mixing solution, where it is combined with the diluent gas (usually purified air). The test gas concentration is calculated from the permeation rate, the flow rate of the diluent gas, and the thickness of the walls of the permeation tube.

**3.1.937** *Permeation Rate* — The rate of movement (mass flux) of the chemical through the barrier. The permeation rate is normally reported in mass per unit area per unit time (e.g.,  $\mu\text{g}/\text{cm}/\text{min}$ ) after equilibrium is reached and may be normalized for thickness.

**3.1.938** *Permeation Tube* — A plastic tube in which is sealed a liquefied gas or volatile liquid that slowly permeates through the walls at a constant rate.

**3.1.939** *Permissible Exposure Limit (PEL)* — The permissible concentration in air of a substance to which nearly all workers may be repeatedly exposed 8 hours a day, 40 h a week, for 30 years without adverse effects.

**3.1.940** *Permissible Exposure Limit-short-term exposure limit (PEL-STEL)* — Short term exposure limit is the employee's 15 min TWA exposure that shall not be exceeded at any time during a workday unless another time limit is specified in a parenthetical notation below the limit.

**3.1.941** *Permissible Heat Exposure Threshold Limit Values* — A limit designed to provide a work temperature and wet bulb globe temperature combination so that 95 percent of the workers would not have a deep body temperature exceeding 38 °C. Work load categories are light work < 200 kcal/h (233 watts), moderate work 200 kcal/h to 350 kcal/h (233 watts to 407 watts), and heavy work 350 kcal/h to 500 kcal/h (407 watts to 581 watts).

**3.1.942 Permit-Required Confined Space/Permit Space** — A confined space that has one or more of the following characteristics:

- a) Contains or has the potential to contain a hazardous atmosphere;
- b) Contains a material that has the potential for engulfing an entrant;
- c) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section; and
- d) Contains any other recognized serious safety or health hazard.

**3.1.943 Peroxide** — A chemical compound that contains the peroxy ( $-O-O-$ ) group, which may be considered a derivative of hydrogen peroxide ( $HOOH$ ).

**3.1.944 Peroxide Former** — A material that reacts with oxygen or hydrogen peroxide to produce a peroxide of the reactant.

**3.1.945 Persistence** — When applied to a chemical this has a meaning of ability to remain unchanged in the environment.

**3.1.946 Personal Sampler** — Air sampling instrument developed for estimating exposure of individual workers to air contaminants.

**3.1.947 Personal Sampling** — The collection of airborne chemicals in the worker's breathing zone done by having the worker wear the sampling equipment throughout the workday.

**3.1.948 Personal Alert Safety Systems (PASS)** — An individual protective device that emits an audible alarm to notify others and assists in locating a firefighter in danger. The personal alert safety system (PASS) device includes a motion detector that senses movement and automatically sounds an alarm signal if no movement is sensed for 30 seconds in case a firefighter is incapacitated and cannot activate the alarm.

**3.1.949 Personal Gas Monitor** — A device carried by an individual to detect toxic gases or an oxygen-deficient atmosphere, which would cause harm to the health of an individual. They generally have an audible, visual, and vibrating alarm that activates at a preset level to warn the wearer of the immediate hazard of the surrounding atmosphere.

**3.1.950 Personal Protection** — The action of shielding the body against contact with known chemical or physical hazards in the environment.

**3.1.951 Perturbation** — Any effect that makes a small modification in a physical system.

**3.1.952 Pesticides** — A descriptor applied to chemicals used to kill pests and minimize their impact in agriculture, health and other human interests. Pesticides are often classified according to the organisms which they are used to control, for example as fungicides, herbicides, insecticides, molluscicides, nematocides, rodenticides, etc.

**3.1.953 Peak side-on overpressure** — The maximum pressure incident to an object exposed to a blast wave.

**3.1.954 Piston Pump** — A hand-held sampling pump that draws a fixed volume of air. It operates by pulling and locking a piston into position while the sample is drawn into the detector tube. The piston is released after the sampling time has elapsed.

**3.1.955 Pitot Tube** — A small bore tube inserted into a flowing stream with its orifice facing the stream to measure total pressure. The term is often used for a double tube instrument from which the flow velocity can be calculated with one orifice facing the flowing stream to register total pressure and other perpendicular to the stream to register static pressure.

**3.1.956 Placard** — A sign or symbol designed to be hung on a wall, container or vehicle containing warning information to convey the level of hazard.

**3.1.957 Plug Flow Reactor (PFR)** — A tube reactor in which the reactants are fed continuously at one end and the products are removed continuously from the other end; concentration and heat generation change along the length of the tube; the PFR is often used for potentially hazardous reactions because of the relatively small inventory in the system.

**3.1.958 Point Source Model** — A thermal energy model based on representing the total heat release as a point source.

**3.1.959 Poison** — A chemical substance or biological material which taken into or formed within the organism, destroys life or impairs the health status.

**3.1.960 Polar Solvent Liquids** — Those liquids that mix (are miscible with water).

**3.1.961 Polymer** — A giant long chain of molecules having extremely high molecular weights made up of many repeating smaller units called monomers or comonomers.

**3.1.962 Polymerization** — Chemical bonding of monomers to form a polymer.

**3.1.963 Positively Buoyant Gas** — A gas with density less than that of air at ambient temperature.

**3.1.964 Powder** — A solid reduced to dust by pounding, crushing or grinding.

**3.1.965 Pressure Relief Device** — A mechanism that vents fluid from an internally pressurized system to counteract system overpressure; the mechanism may release all pressure and shut the system down (as does a rupture disc) or it may merely reduce the pressure in a controlled manner to return the system to a safe operating pressure (as does a spring-loaded safety valve).

**3.1.966 Pressure Safety Valve** — A valve that opens at a preset pressure to relieve excessive pressure within a vessel or piping. It may also be called a Pressure Relief Valve, Relief Valve, or Pop Valve.

**3.1.967 Proactive Safety Measures** — Programs or activities that are undertaken to prevent an incident. Sometimes referred to as leading safety indicators. These may include preparation and implementation of safety policies, standards and procedures, safety communication activities, risk assessments, management of change, audits and inspections, training, continuous safety improvement activities, etc.

**3.1.968 Probability** — The projected frequency of the occurrence of an event, usually based on statistical analysis of past similar events. Used for determining risk levels. May be qualitatively assessed or based on historical data for various types of hazard assessments. May also be sometimes referred to as likelihood.

**3.1.969 Probability of Failure on Demand (PFD)** — A value that indicates the probability that a device or system will fail to respond to a demand in a specified interval of time. PFD equals 1 minus Safety Availability.

**3.1.970 Probit** — A random variable with a mean of 5 and a variance of 1, which is used in various effect models.

**3.1.971 Proof Test Interval** — The time interval between checking a protection system.

**3.1.972 Process Media** — The material (i.e., chemical substances) processed by the equipment.

**3.1.973 Protective Clothing** — An article of clothing furnished to an employee that is worn for personal safety and protection in the performance of work assignments in potentially hazardous areas or under hazardous conditions.

**3.1.974 Protective Apparel** — Garments or accessories, such as shoes, laboratory coat, gloves or goggles that are intended to protect laboratory personnel from injury or chemical exposure.

**3.1.975 Protective Equipment** — Any device such as respirator, safety shield, fume cabinet or manipulator, that is intended to protect laboratory personnel from injury or chemical exposure.

**3.1.976 Protective System** — Systems such as pressure vessel relief valves, that function to prevent or mitigate the occurrence of an incident.

**3.1.977 Puff Model** — A mathematical model used to represent the dispersion of gas from an instantaneous release.

**3.1.978 Puff Release** — See Instantaneous Release.

**3.1.979 pH** — A mean to express and to compare the acidity and alkalinity of a solution. It is expressed in a scale from 0 to 14. The solution of pH 7 is neutral; if the pH is lower than 7 the solution is acidic; if the pH is higher than 7 the solution is alkaline (basic).

**3.1.980 Phased Sampling Scheme** — The conduction of a second sequential set of sampling is based on results of a first set.

**3.1.981 Phi-factor** — A correction factor which is based on the ratio of the total heat capacity of a vessel ( $m_{ves} C_{p,ves}$ ) and the total heat capacity of the vessel contents ( $mC_p$ ). The phi factor =  $1 + (m_{ves} C_{p,ves}/mC_p)$  approaches the value of one for large vessels, for extremely light vessels, or at genuine adiabatic conditions.

**3.1.982 Photo Acoustic Spectroscopy (PAS)** — A spectroscopic technique for investigating solid and semisolid materials, in which the sample is placed in a closed chamber filled with a gas such as air and illuminated with monochromatic of any desired wavelength, with intensity modulated at some suitable acoustic frequency; absorption of radiation results in a periodic heat flow from the sample, which generates sound that is detected by a sensitive microphone attached to the chamber.

**3.1.983 Photo Ionization Detector (PID)** — The PID is a portable, general survey instrument used for detecting leaks, surveying plants to identify problem areas, evaluating source emissions, monitoring ventilation efficiency, evaluating work practices, and determining the need for personal protective equipment for hazardous waste site workers.

**3.1.984 Photon Energy** — Photon energy describes the energy possessed by electromagnetic energy when characterized as discrete bundles, as described by quantum theory. The unit of photon energy is the Joule(J) or the electron volt (eV).

**3.1.985 Physical Factors, Unsafe** — Environmental factors conducive to an incident occurrence, which include physical or environmental hazards.

**3.1.986 Physical Hazard** — A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water reactive.

**3.1.987 Physical Relief Device** — Mechanical equipment that performs an action to relieve pressure when the normal operating range of temperature or pressure has been exceeded. Physical relief devices include pressure relief valves, thermal relief valves, rupture disks, rupture pins, and high temperature fusible plugs.

**3.1.988 Physical Work Capacity (PWC)** — The maximum amount of oxygen that an individual can consume per minute.

**3.1.989 Pilot Operated Safety Relief Valve** — A pressure relief valve in which the major relieving device is combined with and is controlled by a self-actuating auxiliary pressure relief valve.

**3.1.990 Piezoelectric Mass Sensor** — A sensor based on the principle that when crystalline materials are mechanically stressed by compression or tension they produce a voltage proportional to the stress. When these crystals are subjected to an electric current, they oscillate, and the natural vibrational frequency depends on the thickness and density of the crystal.

**3.1.991 Point of Operation Guarding** — Machine guards, such as a hard guards or safety light screens, that are designed to protect personnel from hazardous machine motion when close to the machine's point of operation.

**3.1.992 Point of Perception** — The time and place at which the individual actually first perceived, that is, saw, heard, smelled, or felt the hazard, or the unusual or unexpected movement or condition that could be taken as a sign that the incident is about to occur.

**3.1.993 Point of Possible Perception** — The place and time at which the unusual or unexpected movement or condition could have been perceived by a normal person. This point always comes at or before the point of (actual) perception.

**3.1.994 Pool Fire** — The combustion of material evaporating from a layer of liquid at the base of the fire.

**3.1.995 Policy, Safety** — A declaration by an organization of how it manages loss prevention at its facilities. It reflects the organization's culture, values, and commitment towards health and safety in its workplace.

**3.1.996 Polymer** — Substance made of giant molecules formed by the union of simple molecules (monomers); for example, polymerization of ethylene forms a

polyethylene chain, or condensation of phenol and formaldehyde (with production of water) forms phenol formaldehyde resins.

**3.1.997 Pollutant** — Any undesirable solid, liquid, or gaseous matter in a gaseous, liquid, or solid medium. For the meaning of "undesirable" in air pollution contexts, see pollution. A primary pollutant is a pollutant emitted into the atmosphere from an identifiable source. A secondary pollutant is a pollutant formed by chemical reaction in the atmosphere.

**3.1.998 Pollution** — The introduction of pollutants into a solid, liquid, or gaseous medium, the presence of pollutants in a solid, liquid, or gaseous medium, or any undesirable modification of the composition of a solid, liquid, or gaseous medium. For air pollution, an undesirable modification is one that has injurious or deleterious effects.

**3.1.999 Popping Pressure** — The pressure at which a safety (relief) valve passing compressible fluid pops from partially open to full open with no further increase in the inlet pressure.

**3.1.1000 Potential Exposure** — Exposure that is not expected to be delivered with certainty but that may result from an accident at a source or owing to an event or sequence of events of a probabilistic nature, including equipment failures and operating errors.

**3.1.1001 Potential Hazard** — A situation, thing, or event having latent characteristics conducive to an incident occurrence.

**3.1.1002 Potentiation** — The joint action of two or more chemicals on an organism is more than additive.

**3.1.1003 Pressure** — Thermodynamically, the normal force exerted by a homogeneous liquid or gas, per unit of area, on the wall of the container. Force exerted per unit area.

**3.1.1004 Pressure-drop** — Loss in pressure (as from one end of the refrigerant line to the other) from friction, static, heat etc. The differential pressure across some element of a system, such as a valve or orifice. (Also known as — back pressure).

**3.1.1005 Pressure Relief Valve** — A pressure relief device which is designed to reclose and prevent the further flow of fluid after normal conditions have been restored.

**3.1.1006 Pressure Vessel** — A tank or other container constructed so as to withstand interior pressure greater than that of the atmosphere.

**3.1.1007 Precision** — The closeness of agreement between the results obtained by applying the

experimental procedure several times under prescribed conditions.

**3.1.1008 Preliminary Hazard Analysis (PHA)** — An early or initial screening study for the identification, qualitative review, and ranking of process hazards, typically conducted during an initial evaluation of existing facilities or a project's conceptual design. Recommendations for the mitigation of identified hazards are provided.

**3.1.1009 Preliminary Hazard List (PHL)** — A line item inventory of system hazards, with no evaluation of probability, severity, or risk.

**3.1.1010 Preventive Maintenance** — A systematic procedure by which laboratory components that are most likely to fail are replaced and instruments recalibrated to ensure that the laboratory operates at maximum efficiency.

**3.1.1011 Preventive Measures** — Measures taken at the initial stages of a runaway to avoid further development of the runaway or to reduce and mitigate its final effects.

**3.1.1012 Process** — Any activity involving a chemical including any use, storage, manufacturing, handling, or on-site movement of such chemicals, or combination of these activities.

**3.1.1013 Process Change** — Changing a process to make it less hazardous (e.g., paint dipping in place of pain spraying).

**3.1.1014 Process Controls** — Emission control devices installed on a process or piece of equipment.

**3.1.1015 Process Critical Equipment** — Rotating equipment including turbines, electric driven pumps, compressors or generators handling combustible, flammable or toxic materials, and use drivers equal to or greater than 1 000 HP. Process critical equipment also includes rotating equipment that is categorized as critical by a Process Hazard Analysis.

**3.1.1016 Process Hazard Analysis** — An organized effort to identify and evaluate hazards associated with chemical processes and operations to enable their control. This review normally involves the use of qualitative techniques to identify and assess the significance of hazards. Conclusions and appropriate recommendations are developed. Occasionally, quantitative methods are used to help prioritize risk reduction.

**3.1.1017 Process Hood** — A device to capture, enclose or receive hazards from a process. Hoods enclose a process and capture or receive contaminants.

**3.1.1018 Process Related Incident** — An incident with impact, or potential impact, on process, equipment, people, and/or the environment. The incident could be

internal or external to the process. An occupational incident can result from a process related incident.

**3.1.1019 Process Safety** — A discipline that focuses on the prevention of fires, explosions, and accidental chemical releases at chemical process facilities. Excludes classic worker health and safety issues involving working surfaces, ladders, protective equipment, etc.

**3.1.1020 Process Safety Time** — The period of time between a trip point being reached and a hazardous event occurring if no safety measures such as a shutdown are taken.

**3.1.1021 Process Safety Management** — A program or activity that involves the application of management principles and analytical techniques to ensure process safety in chemical facilities. The focus is on preventing major accidents rather than dealing with classic worker health and safety issues.

**3.1.1022 Process Safety Auditing** — A formal review that identifies process hazards relative to established standards; for example, examining plant and equipment, often using a checklist or other audit guide.

**3.1.1023 Process Safety Management Systems** — Comprehensive sets of policies, procedures, and practices designed to ensure that barriers to episodic incidents are in place, in use, and effective.

**3.1.1024 Process Safety Management Systems Auditing** — The systematic review of process safety management systems, used to verify the suitability of these systems and their effective, consistent implementation.

**3.1.1025 Product Safety** — A scientific process to assess the probability that exposure to a product during any stage of its life cycle will lead to an unacceptable impact on human health or the environment. May also be referred to as product risk characterization or product risk assessment.

**3.1.1026 Proof Test** — Testing of safety system components to detect any failures not detected by automatic on-line diagnostics, i.e., dangerous failures, diagnostic failures, and parametric failures, followed by repair of those failures to an equivalent as new state. Proof testing is a vital part of the safety life cycle and is critical to ensuring that a system achieves its required safety integrity level through out the safety life cycle.

**3.1.1027 Public Health Impact Assessment** — Application of risk assessment procedures to a specific target population. The size of the populations needs to be known. The end product is a quantitative statement about the number of people affected in the specific target populations.

**3.1.1028 Pump** — A mechanical device used in air monitoring to draw the sample gas through a collection device.

**3.1.1029 Pungent** — Sharp or irritating.

**3.1.1030 Purging** — A method by which gases, vapors, or other air contaminants are displaced from a confined space. It is accomplished so that subsequent natural ventilation will not result in the reinstatement of an undesired atmosphere. Purging is commonly accomplished by the use of a protective or inert gas (for example, nitrogen, carbon dioxide, etc.) at a sufficient flow and positive pressure to reduce the concentration of any flammable gas, vapor, or toxic materials initially present to an acceptable level. It may also be called de-gassing.

**3.1.1031 Purging, Clearing** — Replacement of a substance so rapidly so that there is minimum mixing, thus reducing the duration of any explosive mixture.

**3.1.1032 Purging, Dilution** — Introduction of adequate quantities of an inert gas to an enclosure to ensure that explosive mixtures cannot form.

**3.1.1033 Purging, Displacement** — Replacement of one substance with another without appreciable mixing. Displacement purges in pipelines are typically accomplished by separating the two substances with an inert fluid or a mechanical scraper.

**3.1.1034 Purge Gas** — A gas that is continuously or intermittently added to a system to render the atmosphere non-ignitable. The purge gas may be inert or combustible.

**3.1.1035 Pyrolysis** — A chemical decomposition or breaking apart of molecules produced by heating in the absence of air.

**3.1.1036 Pyrolyzer** — A device that thermally decomposes certain gases and vapors, releasing constituents that then can react with the indicating layer in the detector tube.

**3.1.1037 Pyrophoric** — A chemical that will ignite spontaneously in air at a temperature of 130 °F (54.4 °C) or below.

NOTE — that definitions of pyrophoric from other sources may specify a time frame, usually seconds or minutes, within which ignition must be observed.

**3.1.1038 Pyrophoric Gas** — Gaseous materials that spontaneously ignite when exposed to air under ambient conditions. Example: trimethyl aluminium.

**3.1.1039 Pyrophoric Liquid** — Liquid materials that spontaneously ignite when exposed to air under ambient conditions.

**3.1.1040 Pyrophoric Solid** — Solid materials that spontaneously ignite when exposed to air under ambient conditions. An example is phosphorus.

**3.1.1041 Pyrotechnics** — Explosive commodities that have extremely high flame speeds and heat releases. Pyrotechnics are primarily used in fireworks displays and munitions.

## Q

**3.1.1042 Qualitative Risk Analysis** — An evaluation of risk based on the observed hazards and protective systems that are in place as opposed to an evaluation that uses specific numerical techniques.

**3.1.1043 Quantitative Risk Assessment** — The systematic development of numerical estimates of the expected frequency and/or consequence of potential accidents associated with a facility or operation based on engineering evaluation and mathematical techniques.

**3.1.1044 Quasi-Adiabatic** — A vessel condition that allows for small amounts of heat exchange; this condition is typical in testing self-heating by oxidation that is characterized by gas flows (although well-controlled in temperature) into and/or out of the test vessel; this condition is typical as well in tests where heat transfer is avoided by active control, that is, the ambient temperature is kept identical to the test vessel temperature, such that an adiabatic condition is approached.

**3.1.1045 Quenching** — Rapid cooling from an elevated temperature, for example, severe cooling of the reaction system in a short time (almost instantaneously), freezes the status of a reaction and prevents further decomposition.

**3.1.1046 Quench Pool** — A vessel containing liquid and a sparger for quenching an effluent stream. Commonly used for cooling or condensing vapor or vapor-liquid mixtures, or for reacting effluent with a neutralizing agent, or for absorbing hazardous components from an effluent.

## R

**3.1.1047 Rain Out** — When a superheated liquid is released to the atmosphere, a fraction of it will flash into vapor. Another fraction may remain suspended as an aerosol. The remaining liquid, as well as portions of aerosol, may rain out on the ground.

**3.1.1048 Rapid Phase Transition** — An explosive generation of vapor that can occur when a cold volatile liquid contacts a warmer liquid. The cold liquid can superheat to such a degree that homogeneous nucleation can occur resulting in very rapid generation

of vapor. This is the phenomenon involved in LNG-water, hot oil-water, and molten-metal-water explosions. Also referred to as homogeneous nucleation.

**3.1.1049 Reaction** — Any transformation of material accompanied by a change of enthalpy which may be endothermic or exothermic.

**3.1.1050 Reactivity** — Chemical reaction with the release of energy. Undesirable effects (such as pressure build up, temperature increase, formation of noxious, toxic or corrosive by products) may occur because of the reactivity of a substance to heating, burning, direct contact with other materials, or other conditions in use of in storage.

**3.1.1051 Reagent Grade** — A chemical reagent that meets standards for purity set by the American chemical society. These reagents are produced for laboratory use.

**3.1.1052 Reaction Induction Time (RIT) Value** — The time a chemical compound or mixture may be held under isothermal conditions until it exhibits a specific exothermic reaction.

**3.1.1053 Reaction Kinetics** — A mathematical description of reaction rates in terms of concentrations, temperatures, pressures, and volumes that determine the path of the reaction.

**3.1.1054 Reaction Rate Constant** — The constant in the rate of reaction equation; it is a function of temperature as represented in the Arrhenius equation.

**3.1.1055 Reactive Chemical** — A substance that can pose a chemical reactivity hazard by readily oxidizing in air without an ignition source (spontaneously combustible or peroxide forming), initiating or promoting combustion in other materials (oxidizer), reacting with water, or self-reacting (polymerizing, decomposing or rearranging). Initiation of the reaction can be spontaneous, by energy input such as thermal or mechanical energy, or by catalytic action increasing the reaction rate.

**3.1.1056 Reactive Groups** — Categories of chemicals that react in similar ways, often because they are similar in their chemical structure.

**3.1.1057 Reactivity, Chemical** — *see* chemical reactivity.

**3.1.1058 Recognition Process** — A process used to recognize work place hazards.

**3.1.1059 Recommended Alert Limits** — Heat exposure limits for unacclimatized workers.

**3.1.1060 Redox Compound** — Compound with reducing and oxidizing features.

**3.1.1061 Reduced Comfort (RC) Resonance** — The boundaries concerned with preservation of comfort during vibration exposure.

**3.1.1062 Re-entrainment** — Resuspension of particles after they have been settled onto a collecting surface.

**3.1.1063 Regulatory Requirements** — Any legal or statutory legislation, which, in the context of this monograph, relates to laboratory safety, the safe use of chemicals, their storage, disposal, monitoring of laboratory personnel etc.

**3.1.1064 Reflux** — A system condition in which a component in the reaction system (usually a solvent or diluent) is continuously boiled off, condensed in a nearby condenser, and then returned to the reaction system; reflux is often used to operate at a preset temperature or to avoid operating at unacceptably high temperatures.

**3.1.1065 Relative Risk Analysis** — A hazardous material risk that is evaluated in comparison to another risk. The type of risk analysis used should be appropriate for the available data and to the exposure, frequency, and severity of potential loss.

**3.1.1066 Relative Risk Index Model - Pipe Line** — A relative risk index model is an analytical model or tool that is used to calculate a numerical score, representing the relative risk of a pipeline segment. This score is calculated based on variables that represent characteristics of the pipeline segment and the perceived importance of these characteristics to the risk of the segment.

**3.1.1067 Relief Valve** — A pressure relief valve actuated by inlet static pressure having a gradual lift dependent on the increase in pressure over the opening pressure. It may be provided with an enclosed spring housing suitable for closed discharge system application and is primarily used for liquid service.

**3.1.1068 Relieving Capacity** — The flow rate through a pressure relieving system calculated for a designated temperature, set pressure and overpressure, using a flow area and coefficient of discharge (or resistance factors for rupture disk device systems) determined in certification tests or otherwise specified in ASME BPVC. For pressure relief devices covered under the ASME BPVC but normally not capacity-certified, and for low pressure relief devices not covered by the ASME BPVC, the relieving capacity is based on the manufacturer's calibration data.

**3.1.1069 Relieving Pressure** — Relieving pressure is the set pressure plus overpressure.



**3.1.1070 Remote-Sensing Pressure Relief Valve** — A pilot operated safety relief valve in which the pressure signal is obtained remotely from the valve body (e.g., from the vessel being protected).

**3.1.1071 Response** — That portion of incident management in which personnel are involved in controlling a hazardous materials incident.

**3.1.1072 Resinification** — A process involving slow polymerization of low molecular weight substances, sometimes induced by exposure to air.

**3.1.1073 Residual Risk** — The risk remaining after preventive measures have been taken. Although preventive measures may have been implemented and effective, a residual risk will also be present if an operation or a facility continues to exist.

**3.1.1074 Return Procedure** — Part of a safety plan intended to ensure that personnel do not return to a laboratory area until an emergency situation is ended.

**3.1.1075 Risk** — A measure of economic loss or human injury in terms of both the incident likelihood and the magnitude of the injury.

**3.1.1076 Risk Analysis** — The development of a quantitative estimate of risk based on engineering evaluation and mathematical techniques for combining estimates of incident consequences and frequencies

**3.1.1077 Risk Analyst** — An individual who analyzes historical loss data, prepares loss models, estimates potential losses, and investigates and applies emerging research methodologies for preparing loss predictions. Primarily used in the insurance industry.

**3.1.1078 Risk Assessment** — A process by which the results of a risk analysis (i.e., risk estimates) are prepared for use in decisions, either through relative-ranking of risk reduction strategies or through comparison with risk criteria.

**3.1.1079 Risk Assessment Management Process** — A global term for the whole activity from hazard identification to risk management

**3.1.1080 Risk Attitude** — A decision maker's preferences towards facing variation in possible losses and gains. In decision analysis, risk attitude is expressed mathematically through a utility function.

**3.1.1081 Risk-averse** — A description of a decision maker's risk attitude in which the value for a risky alternative is lower than the expected value of the alternative.

**3.1.1082 Risk Avoidance** — The philosophy of risk management that an entity will not enter into an operation that poses an exposure of loss or will

eliminate the exposure to a potential loss. [Ex: The replacement of a manual handling operation by a mechanical handling system. Primarily used in the risk management practices for corporate cost benefit in the analysis of insurance applications.]

**3.1.1083 Risk-Based Inspection (RBI)** — A frequency of inspection based on an evaluation of the hazard versus severity, i.e., the risk the facility represents, whereby high-risk facilities would be inspected more frequently than low-risk facilities. This focuses resources more beneficially to the appropriate potential high-risk facilities to improve safety.

**3.1.1084 Risk Control** — The provision of suitable measures or elements to eliminate or control real or potential hazards. Risk control may be done through risk avoidance, risk retention, risk transfer, or risk reduction measures. *see also* Risk Avoidance; Risk Management; Risk Reduction; Risk Retention; Risk Transfer.

**3.1.1085 Risk Factor** — A characteristic or agent whose presence increases the probability of occurrence of a disease or injury.

**3.1.1086 Risk Graph** — A qualitative and category-based method of safety integrity level (SIL) assignment. Risk graph analysis uses four parameters to make a SIL selection: consequence, occupancy, probability of avoiding the hazard, and demand rate. Each of these parameters is assigned a category and a SIL is associated with each combination of categories. In some cases, quantitative tools, such as Layers of Protection Analysis (LOPA), are used to assist the analyst in determining which category to use, but typically the assignment is done qualitatively. Using the selected categories, the analyst follows the resulting path that leads to the associated SIL assignment.

**3.1.1087 Risk Integral** — A summation of risk as expressed by the product of consequence and frequency. The integral is summed over all of the potential unwanted events that can occur. If calculating the risk integral for loss of life, the consequence of concern and thus the units of the integral are fatalities. It is useful in combination with event trees to determine a total value of risk for a group of related incidents.

**3.1.1088 Risk Characterization** — The outcome of hazards identification and risk estimation applied to a specific use or occurrence of an environmental health hazard (e.g., a chemical compound). The assessment requires quantitative data on the human exposure in the specific situation. The end product is a quantitative statement about the proportion of affected people in a target population.

**3.1.1089 Risk Contour** — Lines that connect points of equal risk around the facility ("iso-risk" lines).

**3.1.1090 Risk Estimation** — The quantification of dose-effect and dose-response relationships for a given environmental agent, showing the probability and nature of the health effects of exposure to the agent.

**3.1.1091 Risk Evaluation** — The assessment of risk, coupled with an appraisal of the significance of the results, both overall and from individual events.

**3.1.1092 Risk Management** — The systematic application of management policies, procedures, and practices to the tasks of analyzing, assessing, and controlling risk in order to protect employees, the general public, and the environment as well as company assets, while avoiding business interruptions. Includes decisions to use suitable engineering and administrative controls for reducing risk.

**3.1.1093 Risk Management Techniques** — Various methods available to handle a hazard, which primarily include risk avoidance, risk reduction, risk control, and risk acceptance.

**3.1.1094 Risk Marker** — (synonym : risk indicator) An attribute that is associated with an increased probability of occurrence of a disease or other specified outcome and that can be used as an indicator of this increased risk. Not necessarily a causal factor.

**3.1.1095 Risk Monitoring** — The process of following up decisions and actions within risk management in order to check whether the aims of reduced exposure and risk are achieved.

**3.1.1096 Risk Measures** — Ways of combining information on likelihood with the magnitude of loss or injury (e.g., risk indices, individual risk measures, and societal risk measures).

**3.1.1097 Risk Rating** — A rating of a risk from lowest to highest or vice versa. A rating is usually derived from a risk matrix assessing the risk from frequency or probability (high to low) against its consequences (minor to severe), whereby the function of the two provide a relative ranking of the risk compared to other risks, and the result will indicate the level of action that is required to resolve the risk.

**3.1.1098 Risk Reduction** — The lowering of a loss exposure through the provision of risk avoidance, prevention techniques, loss control measures, or risk financing instruments.

**3.1.1099 Risk Retention** — A risk management strategy where the risk is retained within an organization and any consequent loss is financed by the organization. There are considered to be two types: risk retention with knowledge and risk retention without knowledge. With knowledge a conscious decision is made to meet any resulting loss from within the organization's resources.

Decisions on which risk should be retained should only be decided after all the risks have been identified, measured, and evaluated. Without knowledge are those that arise from a lack of knowledge of the existence of a risk or an omission to insure against that risk. Risks that have not been identified and evaluated are a form of risk retention.

**3.1.1100 Risk Threshold** — A level of risk at which society, organizations, employees, or an individual are prepared to accept in terms of risk acceptance, e.g., an individual crossing a road in heavy traffic.

**3.1.1101 Risk Transfer** — Shifting a risk by the means of a two-party contract, typically an insurance contract.

**3.1.1102 Risk Targets** — Objective-based risk criteria established as goals or guidelines for performance.

**3.1.1103 Rule Based Action Behavior** — Behavior in which a person follows remembered or written rules. (Ex: the use of a written checklist to calibrate an instrument or a maintenance manual to repair a pump)

**3.1.1104 Risk-neutral** — A description of a decision maker's risk attitude in which the value for a risky alternative is equal to the expected value of the alternative.

**3.1.1105 Risk-preferring** — A description of a decision maker's risk attitude in which the value for a risky alternative is higher than the expected value of the alternative.

**3.1.1106 Risk profile** — A cumulative probability distribution over the range of values associated with all possible outcomes resulting from selecting a given alternative.

**3.1.1107 Rodenticide** — A chemical used to kill rodents (rats).

**3.1.1108 Routinely Collected Data** — Various types of exposure and health data that are collected routinely in the occupational setting for use in surveillance programs.

**3.1.1109 Runoff** — Excess water produced during fire fighting or from rain.

**3.1.1110 Runaway Reaction** — A thermally unstable chemical reaction system which shows an accelerating increase of temperature and reaction rate. The runaway reaction can finally result in vessel failure.

**3.1.1111 Rupture Disk Device**

**3.1.1111.1** A non-reclosing pressure relief device actuated by inlet static pressure and designed to function by the bursting of a pressure containing disk. Also called a frangible disk device or a bursting disk device.

**3.1.1111.2** A non-reclosing differential pressure relief device actuated by inlet static pressure and designed to function by bursting the pressure containing rupture disk. A rupture disk device includes a rupture disk and a rupture disk holder.

## S

**3.1.1112** *Safe* — In occupational health, when a situation is safe it is meant that it is from an unacceptable amount of risk rather than free from all risk. Something is thus safe if its actual risk is judged to be acceptable.

**3.1.1113** *Safe Failure* — A failure that does not have the potential to put the safety instrumented system in a dangerous or fail-to-function state. The situation when a safety-related system or component fails to perform properly in such a way that it calls for the system to be shut down or the safety instrumented function to activate when there is no hazard present.

**3.1.1114** *Safe Failure Fraction (SFF)* — The fraction of the overall failure rate of a device that results in either a safe fault or a diagnosed (detected) unsafe fault. The safe failure fraction includes the detectable dangerous failures when those failures are annunciated and procedures for repair or shutdown are in place.

**3.1.1115** *Safe Holding Distance* — A method of safeguarding that protects the operator by requiring the operator to hold the work piece at a distance from the hazard area such that the operator cannot reach the hazard portion of the machine cycle.

**3.1.1116** *Safe Opening Safeguarding* — A method of safeguarding that limits access to the hazard area by the size of openings, or by closing off access, when the work piece is in place in the machine.

**3.1.1117** *Safe Position of Controls Safeguarding* — A method of safeguarding that requires the operator to be positioned at the machine controls at a distance from the hazard area such that the operator cannot reach the hazard area during the hazardous portion of the machine cycle.

**3.1.1118** *Safe Refuge* — A location free of risk from an incident of concern. An area designated as safe refuge has the capability to provide protection against the designated emergency, i.e., fire, explosion, toxic gases, etc. *see also* Evacuation; Shelter-in-Place.

**3.1.1119** *Safe State* — The predetermined safe position of the process equipment device under control, as determined by operational experience, a preliminary hazards analysis, or formal Hazard and Operability (HAZOP) study. Unless otherwise specified, the safe-state is de-energized, i.e., without power, pneumatic, or hydraulic supply. It is also the state of the process after acting to remove the hazard resulting in no

significant harm.

**3.1.1120** *Safe Practices in Laboratories* — Accepted methods of working in a laboratory so as to comply with the relevant safety plan.

**3.1.1121** *Safe Working Load (SWL)* — Generally taken as the maximum load that an item of equipment (e.g., crane) may raise, lower, or suspend under particular service conditions and arrangements. Each individual type of equipment has its own specific safe working load limits.

**3.1.1122** *Safe Workplace* — One in which the likelihood of all identifiable undesired events are maintained at an acceptable level.

**3.1.1123** *Safeguard* — A precautionary measure or stipulation. Usually equipment or procedures designed to interfere with an incident propagation to prevent or reduce incident consequences.

**3.1.1124** *Safety* — A general term denoting an acceptable level of risk of, relative freedom from, and low probability of harm.

**3.1.1125** *Safety (of A Drug or Other Chemical Substance For Human Health)* — The extent to which a chemical substance may be used in the amounts necessary for intended purposes with a minimum risk of adverse health effects.

**3.1.1126** *Safety Alert Symbol* — A symbol used on a safety sign that indicates a potential personal injury hazard as defined in American National Standards Institute (ANSI) Z535.4. It is composed of an equilateral triangle surrounding an exclamation mark. The color of the sign signifies its hazard level: red for danger, orange for warning, and yellow for caution. The safety alert symbol is not to be used to alert persons to property damage only incidents.

**3.1.1127** *Safety Availability* — The fraction of time that a safety system is able to perform its designated function when the process is operating. The safety system is unavailable when it has failed dangerously or is in bypass. Safety availability is equal to 1 minus the Probability of Failure on Demand of the safety function. *See also* Probability of Failure on Demand (PFD).

**3.1.1128** *Safety Award* — An item provided to a worker, group, or organization to recognize its safety performance in accordance with an organization's goals. The award helps promote prevention of workplace injuries and illness and motivate employees to improve their safety performance. *see also* Safety Recognition Program.

**3.1.1129 Safety Belt (Waist Belt)** — A robust and secure belt worn by an individual (e.g., telephone line worker, window washers, construction worker, etc.) attached to a secure object (telephone pole, window sill, anchor point, etc.) via a safety lanyard, to prevent injury due to falling. They are intended for use where mobility can be limited, and where the combined effects of the anchorage point position and length of the lanyard limits the potential drop of the individual in case the individual falls. Also can refer to a seat or torso belt securing a passenger in an automobile or airplane to provide body protection during a collision, sudden stop, air turbulence, etc.

**3.1.1130 Safety Awareness** — General appreciation by personnel of necessary safety requirements for the tasks in hand.

**3.1.1131 Safety Can** — A small, approved metallic can of not more than 18.9 liters (5 gallons) capacity equipped with a spring closing lid, which will safely relieve pressures when exposed to a fire.

**3.1.1132 Safety Case** — A formal examination of methods to be adopted to reduce the risk of an incident. It is often used in high potential risk applications, i.e., petroleum installations, nuclear facilities, etc.

**3.1.1133 Safety Chain (Towing)** — Chains that are utilized to prevent a trailer from separating from its towing vehicle in event of the hitch's failure. The chains should be arranged so they are crossed in an X fashion below the ball mount, with enough slack that they do not restrict turning or allow the coupler to hit the ground. This prevents the trailer tongue from dropping to the ground if the connection becomes undone. Safety chains should be rated to equal or greater than twice the maximum gross trailer weight rating.

**3.1.1134 Safety Committee** — A team of employees formed to advise and promote the safety and health of the workplace. Members should include representative employees and management from all sections of an organization.

**3.1.1135 Safety Communication** — The collective means by which safety information is disseminated to employees, including the classroom, departmental safety meetings, and written communications such as posters, newsletters, and postings of regulatory agency inspection findings.

**3.1.1136 Safety Competition** — A safety promotion and motivation program to enhance an organization's safety performance by organizing a competition among various groups or departments for the best safety achievements (e.g., incident statistics, proactive safety activities). The winner of the competition is provided with a recognition or award for their efforts.

**3.1.1137 Safety Consequences** — A failure has safety consequences if it causes a loss of function or other damage that could cause injury or result in a fatality.

**3.1.1138 Safety Coordinator** — Individuals within organizations who assist in implementing the workplace safety program in their respective areas.

**3.1.1139 Safety Coupling** — A friction coupling adjusted to slip at a predetermined torque to protect the rest of the system from overload.

**3.1.1140 Safety Coordinator/Officer** — Individual whose task it is to ensure safe day to day operation of a part or whole of the laboratory.

**3.1.1141 Safety Cuffs** — An extended piece of protective shirt material attached by a seam at the wrist. Safety cuffs provide additional protection to the wrist area and slide on and off easily. Safety cuffs are typically made of more rigid material and remain firm even when exposed to perspiration.

**3.1.1142 Safety Cut-Out** — An overload protective device in an electric circuit.

**3.1.1143 Safety Device** — Any kind of device, item, or system that is used in or on equipment and that controls or monitors any aspect of the safety of the equipment and includes a safety relief device.

**3.1.1144 Safety Distance** — The minimum distance from each control-actuating device of a two-hand control system to the hazard point such that the operator cannot reach the hazard point with a hand or other body part before cessation of motion of the hazardous portion of the machine cycle. *see* also separation distance (safety light screen).

**3.1.1145 Safety Education** — The transmission of knowledge, skills, attitudes, motivations, etc., concerning the safety requirements of operations, processes, environments, etc., to workers, supervisors, managers, and others.

**3.1.1146 Safety Engineering** — Safety engineering is concerned with the planning, development, improvement, coordination, and evaluation of the safety component of integrated systems of individuals, materials, equipment, and environments to achieve optimum safety effectiveness in terms of both protection of people and protection of property.

**3.1.1147 Safety Equal** — A slogan commonly used in industry to highlight the fact that safety considerations are equal to production concerns. Its use has recently risen, since there have been incidents where production concerns were considered of higher value than plant shutdown, but eventually this led to a higher losses. Another concern was that the slogan Safety First was not being seriously applied due to production demands.

**3.1.1148 *Safety First*** — A slogan commonly used in industry to highlight the importance of safety in its operations.

**3.1.1149 *Safety Function*** — A specific task or purpose that must be accomplished for safety.

**3.1.1150 *Safety Fuse*** — It consists of a train of slow burning gun powder enclosed in waterproof covering and used for initiation of a detonator or an explosive charge from a safe distance.

**3.1.1151 *Safety Glasses*** — Protective eyewear from impacts that may have side shields. They may also be called Safety Spectacles. They are required to meet American National Standards Institute (ANSI) Z87 and be clearly marked with the manufacturer's name.

**3.1.1152 *Safety and Health Organization*** — An established structure of responsible persons throughout a work place, whereby safe working practices may be developed and promulgated.

**3.1.1153 *Safety Gloves*** — Gloves used to protect the hands of individuals from physical injury (cuts, abrasions, temperature extremes, electrical shock, etc.), chemical hazards, biological hazards, and radioactive hazards.

**3.1.1154 *Safety Handbook*** — Generally a publication that provides information on an organization's safety policies, responsibilities, rules, procedures, and guidelines for its employees.

**3.1.1155 *Safety Helmet*** — Rigid headgear of varying materials designed to protect the head, not only from impact, but from flying particles and electric shock, or any combination of the three. Safety helmets should meet the requirements of American National Standards Institute (ANSI) Standard Z89.1, Protective Headware for Industrial Workers

**3.1.1156 *Safety Injury*** — The classification for an occupational injury which includes all disabling work injuries and non-disabling work injuries as follows: eye injuries requiring treatment by a physician, fractures, injuries requiring hospitalization, loss of consciousness, injuries requiring treatment by a doctor and injuries requiring restriction of motion or work, or assignment to another job.

**3.1.1157 *Safety Inspections*** — An inspection conducted by those who are classified as safety specialists.

**3.1.1158 *Safety Instrumented Function (SIF)*** — A set of equipment intended to reduce the risk due to a specific hazard (a safety loop). Its purpose is to (1) automatically take an industrial process to a safe state when specified conditions are violated; (2) permit a process to move forward in a safe manner when specified conditions allow (permissive functions); (3)

take action to mitigate the consequences of an industrial hazard. It includes elements that detect when an incident is imminent, decide to take action, and then carry out the action needed to bring the process to a safe state. Its ability to detect, decide, and act is designated by the safety integrity level (SIL) of the function. *see also* Safety Integrity Level (SIL).

**3.1.1159 *Safety Instrumented System (SIS)*** — Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s). ASIS usually has a number of safety functions with different safety integrity levels (SIL) so it is best to avoid describing it by a single SIL.

**3.1.1160 *Safety Interlock Switch*** — A switch used on guard doors that is used to detect if the door is opened while the machine is running, and uses a coded actuator to prevent intentional defeat. Safety interlock switches use positive opening contacts, which ensure that the closed switching contact is forced open when the guard is opened, without reliance upon spring action.

**3.1.1161 *Safety Issues*** — Deviations from current safety standards or practices, or weaknesses in facility design or practices identified by plant events, with a potential impact on safety because of their impact on defense in depth, safety margins, or safety culture.

**3.1.1162 *Safety Lamp or Davy Lamp*** — A lamp used in areas of combustible gas that prevents ignition of the gas by the provision of a wire screen, which encloses the lamp flame. The wire screen absorbs the heat of the (oil lamp) light source before it can contact a gas, thereby preventing its ignition. Invented by the British chemist Sir Humphry Davy (1778 – 1829) in 1815 for use by coal miners where firedamp was present. George Stephenson (1781–1848), a British inventor and engineer, also independently invented a similar miner's safety lamp at about the same time but shared credit for this invention with Sir Humphry Davy.

**3.1.1163 *Safety Lock*** — A lock that can be opened only by its own key. Often used to lock out the electrical energized sources used in equipment or machinery operation.

**3.1.1164 *Safety Layer*** — A system or subsystem that is considered adequate to protect against a specific hazard. The safety layer

- is totally independent of any other protective layers
- cannot be compromised by the failure of another safety layer
- must have acceptable reliability
- must be approved according to company policy and procedures
- must meet proper equipment classification

- may be a noncontrol alternative (i.e., chemical, mechanical)
- may require diverse hardware and software packages
- may be an administrative procedure

**3.1.1165 *Safety Measure*** — Any action that might be taken, condition that might be applied, or procedure that might be followed to fulfill the basic requirements of safety.

**3.1.1166 *Safety Meeting*** — A periodic meeting held by employers to communicate and evaluate safety and health issues brought up by employees.

**3.1.1167 *Safety Monitoring*** — Periodic checks on the implementation of an organization's safety standards and procedures.

**3.1.1168 *Safety Net System*** — A method to protect workers that are exposed to falls of more than 182.9 cm (6 ft), primarily used on construction sites. It consists of a net arranged underneath a fall hazard to catch an individual to prevent injury.

**3.1.1169 *Safety Newsletter*** — Typically a monthly publication used to communicate safety information to individuals of an organization. It may summarize the leading and lagging safety indicators of the organization, provide articles of safety interest, and highlight recent standards or regulatory changes that are pertinent to the operation.

**3.1.1170 *Safety Pays*** — A slogan used to justify the utilization of safety procedures, controls, or equipment. Its basis is that the potential cost of injuries and damages outweighs the cost of safety improvements, and therefore it is beneficial from a business perspective.

**3.1.1171 *Safety Perception Survey*** — A safety examination tool that measures the attitudes, perceptions, and motivation of employees towards safety that influence its safety culture and safety behaviors. It typically consists of a specifically constructed set of questions that are answered with a ranking scale, that are submitted to a sample of the workforce, the results of which are analyzed for possible safety improvements.

**3.1.1172 *Safety Pin*** — A pin with a covered point. It is usually constructed as a loop-shaped pin that fastens into itself with its point under a protective cover to prevent opening or injury. Can also be referred to as a pin that prevents detonation for explosives, i.e., a pin when properly inserted prevents inadvertent or premature detonation, e.g., in a grenade.

**3.1.1173 *Safety Poster*** — A communication and motivation tool used to easily highlight by a graphic means a safety message, which can be placed at a highly observable location for individuals to *see*.

**3.1.1174 *Safety Procedure*** — A set of instructions designed for the protection of personnel. Typical safety procedures include incident reporting and investigation, first aid or medical assistance arrangements, waste disposal, emergency response plan instructions, work permits, confined space entries, personal protection requirements, etc.

**3.1.1175 *Safety Professional*** — An individual who, by virtue of specialized knowledge and skill, training, and educational accomplishments, identifies hazards and develops appropriate controls for these hazards, that when effectively implemented, prevent occupational injury, illness, and property damage. These individuals may also have been awarded or earned the status of Certified Safety Professional by the Board of Certified Safety Professionals.

**3.1.1176 *Safety Program*** — All of an organization's written safety policies, standards, and procedures applicable to its operations. This typically includes corporate safety policy, management and employee responsibilities, safety rules, incident management, training, records, audits and inspections, disciplinary policy, incentive or motivation, and safety communication and committees.

**3.1.1177 *Safety Recognition Program*** — A program to promote on-the-job and off-the-job safety awareness by recognizing individuals and group safety achievements that achieve an organization's safety goals. *see* also Safety Award.

**3.1.1178 *Safety Representative*** — An individual that is charged with monitoring and assessing safety hazards or unsafe conditions, and developing and advising measures to prevent an incident from occurring. They may also be called Safety Officers.

**3.1.1179 *Safety Relief Valve*** — A safety relief valve is a pressure relief valve characterized by a rapid opening pop action or by opening generally proportional to the increase in pressure over the opening pressure. It may be used for either compressible or incompressible fluids, depending in design, adjustments or application.

**3.1.1180 *Safety Review*** — An inspection of a plant or process unit, drawings, procedures, emergency plans, and/or management systems, etc., usually by a team and usually problem-solving in nature.

**3.1.1181 *Safety Rule*** — A directive stating minimum safeguarding requirements, procedures, personal protective equipment, and behavior for work activities to avoid injury and damage.

**3.1.1182 *Safety Sampling*** — A systematic sampling of particular dangerous activities, processes, or areas.

**3.1.1183 Safety Shoe** — Personal protective equipment used to protect the foot from a variety of hazards. They are required to meet certain industry performance standards to be acceptable as protective equipment for individuals.

**3.1.1184 Safety Shower** — An emergency system designed to provide immediate water application to an individual's face or body who has been in contact with hazardous chemicals, chemical compounds, or fire. They can be used in four basic ways as follows:

- Dilution: The water reduces the concentration of chemical on the skin to an acceptable level.
- Cooling or warming: Water warms or cools the body due to chemical reaction exposure, which has caused a temperature hazard.
- Irrigation: The water flushes the chemical away.
- Extinguishment: The water can extinguish a clothing fire.

A safety shower provides cascading water over the entire body and face. It is not meant for flushing the eyes with water, which should be provided by an eye wash facility.

**3.1.1185 Safety Sign** — A visual alerting device in the form of a sign, label, decal, placard, or other marking that advises the observer of the hazard(s) that can cause an incident and the level of hazard seriousness. It may also provide other directions to eliminate or reduce the hazard and may advise of the probable consequences of not avoiding the hazard.

**3.1.1186 Safety Symbol** — A graphic representation that portrays a hazard or concern without the use of words. It may represent a hazard, hazardous situation, precaution to avoid a hazard, the result of not avoiding the hazard, or any combination of these messages.

**3.1.1187 Safety System** — Equipment and/or procedures designed to respond to an accident event sequence by preventing accident propagation, thereby preventing the accident and its consequences.

**3.1.1188 Safety System Settings**—The levels at which protective devices are automatically actuated in the event of anticipated operational occurrences or incident conditions, to prevent safety limits from being exceeded.

**3.1.1189 Safety Talk** — A communication tool used to inform workers about health and safety requirements for the tools, equipment, materials, and procedures they use every day, for a particular job, or how to deal with specific problems on site. They do not replace formal training. A safety talk is usually five minutes in duration.

**3.1.1190 Safety Task** — The sensing of one or more variables indicative of a specific postulated initiating event, the signal processing, the initiation and completion of the safety actions required to prevent the limits specified in the design basis from being exceeded, and the initiation and completion of certain services from the safety system support features.

**3.1.1191 Safety through Design** — The integration of hazard analysis and risk assessment in the early design phases of a project and the implementation of the necessary actions to achieve an acceptable level of risk for injury or damages. Typically this entails facilities, hardware, equipment, tools, materials, layout, configurations, energy controls, environmental aspects, and products.

**3.1.1192 Safety Training** — Specific training given to all personnel to enable them to carry out their jobs safely.

**3.1.1193 Safety Valve** — A pressure relief valve actuated by inlet static pressure and characterized by rapid opening or pop action. It is normally used for steam and air services.

NOTE — A distinction is made between low lift safety valves (discharge area is determined by position of disk) or full lift safety valves (discharge area is not determined by position of disk). Used also for gases and vapors in process services.

**3.1.1194 Safety Zone**—An area free of the hazard of concern.

**3.1.1195 Sample/Sampling**— Selecting a portion of a group of data in order to determine the accuracy or propriety or other characteristics of the whole body of data.

**3.1.1196 Sample Volume** — The amount of air pulled through the collection device by a pump during sampling.

**3.1.1197 Sampler Capacity** — A predetermined conservative estimate of the total mass of contaminant that can be collected on the sampling medium without loss or overloading; typically two-thirds of the mass of contaminant on the sorbent at the breakthrough volume.

**3.1.1198 Sampling Time** — The length of time in atmospheric dispersion testing over which concentration data are sampled. Sampling time is normally synonymous with averaging time.

**3.1.1199 Sampling Error** — Part of the total estimation error of a parameter due to the random nature of the sample.

**3.1.1200 Sampling Media** — Devices used to collect airborne chemicals for subsequent analysis, such as sorbent tubes, bags and filters.

**3.1.1201 Scald** — A burn injury that may be caused by the direct exposure to hot liquid, steam, or a hot gas.

**3.1.1202 Scenario** — (In the context of identifying incompatibilities) A detailed physical description of the process whereby a potential inadvertent combination of materials may occur.

**3.1.1203 Seat** — The pressure containing contact between the fixed and moving portions of the pressure containing elements of a valve.

**3.1.1204 Secondary Pressure** — Secondary pressure in a safety, safety relief, or relief valve is the pressure existing in the passage between the actual discharge area and the valve outlet.

**3.1.1205 Sediment** — Material that occurs on the bottom of a water stream and is the result of sedimentation of suspended matter.

**3.1.1206 Sedimentation** — The effect of gravitational forces resulting in the separation of particles from the fluid in which they are suspended.

**3.1.1207 Selectivity** — The ratio of the amount of a desired product obtained to the amount of a key reactant converted.

**3.1.1208 Self Accelerating Decomposition Temperature** — Certain compounds such as organic peroxides and some swimming pool chemicals, when held at moderate ambient temperatures for an extended period of time, may undergo an exothermic reaction that accelerates with increase in temperature. If the heat liberated by this reaction is not lost to the environment, the bulk material increases in temperature, which leads to an increase in the rate of decomposition. Unchecked, the temperature grows exponentially to a point at which the decomposition cannot be stopped or slowed. The minimum temperature at which this exponential growth occurs in a material packed in its largest standard shipping container is defined as the self-accelerating decomposition temperature (NFPA 49, 1994). The result applies only to the specific container used.

**3.1.1209 Self-Heating Material** — A material that when in contact with air and without an energy source, is liable to self-heat.

**3.1.1210 Self-Reactive** — Capable of polymerization, decomposition or rearrangement. Initiation of the reaction can be spontaneous, by energy input such as thermal or mechanical energy, or by catalytic action increasing the reaction rate.

**3.1.1211 Semi-Batch Reactor (SBR)** — A type of batch reactor from which at least one reactant is withheld and then added at a controlled rate, usually to control the rate of heat generation or gas evolution; both heat generation and concentrations vary during the reaction process; products are removed from the reactor only upon conclusion of the reaction process.

**3.1.1212 Sensitivity** — The sensitivity of a measure to a parameter is defined as the change in the measure per unit change in the parameter. How much an output of a model changes with change in one or more inputs.

**3.1.1213 Sensitivity Analysis** — A technique in which one or more parameters are varied to examine their impact on a pressure.

**3.1.1214 Shear Pin Device** — A non-reclosing pressure relief device actuated by inlet static pressure and designed to function by the shearing of a load carrying pin which supports a pressure containing member.

**3.1.1215 Shock Hazard** — The potential release of energy caused by contact or approach to energized electrical conductors or circuit parts.

**3.1.1216 Shock Sensitive** — A relatively unstable material, the energetic decomposition of which can be initiated by merely the input of mechanical energy at normal ambient conditions. Materials are considered as shock sensitive if they are more easily initiated than dinitrobenzene in a standard drop-weight test.

**3.1.1217 Shock Wave** — A compression wave caused by sudden rise of pressure due to release of large quantity of gaseous products at high temperature resulting from decomposition of the explosive material.

**3.1.1218 Sheltering** — Physical protection (such as an enclosed building) against the outcome of an incident.

**3.1.1219 Shelter in Place** — Protect people without evacuating by keeping them inside a building with windows and doors closed and external ventilation systems shut off until a hazardous situation has resolved.

**3.1.1220 Side-On Pressure** — The pressure that would be recorded on the side of a structure parallel to the blast.

**3.1.1221 Signaling Device** — An alarm system component such as a bell, buzzer, horn, speaker, light, or text display that provides an audible, visible, or tactile output to announce a condition of concern.

**3.1.1222 Silica Gel** — A regenerative absorbent consisting of amorphous silica. Used in dehydrating and in drying and as a catalyst carrier.



**3.1.1223 Siren** — A high-pitched wailing sound readily distinguishable from whistles, horns, or other monotone audible devices and easily discernable from the confusion of other sounds. Sirens are commonly employed to announce an emergency condition.

**3.1.1224 Slurry** — Pourable mixture of solid and liquid.

**3.1.1225 Smog** — Smoke and fog: extensive atmospheric contamination by aerosols arising from a combination of natural and anthropogenic sources.

**3.1.1226 Smoke** — 1. Carbon or soot particles less than 1.0 µm in size. These small, gas-phase particles created by incomplete combustion, consist predominantly of carbon and other combustible materials. Smoke generally contains droplets and dry particles. Size ranges are usually between 0.01 µm and 1.0µm.

2. A mixture of dry and liquid particles generated by incomplete combustion of an organic material, combined with and suspended in the gases from combustion.

**3.1.1227 Snuffing Steam** — Pressurized steam used to smother and inhibit fire conditions.

**3.1.1228 Societal Risk** — A measure of risk to a group of people. It is most often expressed in terms of the frequency distribution of multiple casualty events.

**3.1.1229 Solution** — Mixture in which the components lose their identities and are uniformly dispersed. All solutions are composed of a solvent (water or other fluid) and the substance dissolved called the solute. Air is a solution of oxygen and nitrogen. A true solution is homogeneous as salt in water.

**3.1.1230 Solubility** — The degree to which one material may be completely mixed with or dissolved in another material.

**3.1.1231 Solvent** — A substance that dissolves other substances, most commonly water but often an organic compound.

**3.1.1232 Solvent Extraction** — The process of extracting adsorbed chemicals from sorbent material through the use of solvents.

**3.1.1233 Solid Plume Radiation Model** — A thermal radiation model that assumes that entire visible volume of the flame emits thermal radiation, and the non-visible gases do not.

**3.1.1234 Sonometer** — A device for testing acuteness of hearing.

**3.1.1235 Sorbent** — A material that removes gases and vapors from air passed through a canister or cartridge.

**3.1.1236 Sound** — An oscillation in pressure, stress, particle displacement, particle velocity, etc., that is propagated in an elastic material, in a medium with internal forces (e.g., elastic, viscous), or the superposition of such propagated oscillations. Sound is also the sensation produced through the organs of hearing, usually by vibrations transmitted in a material medium, commonly air.

**3.1.1237 Sound Absorption** — The change of sound energy into some other form, usually heat, in passing through a medium or on striking a surface. In addition, sound absorption is the property possessed by materials and objects, including air, of absorbing sound energy.

**3.1.1238 Sound Analyzer** — A device for measuring the band-pressure level or pressure-spectrum level of a sound as a function of frequency.

**3.1.1239 Sound Intensity** — The average rate at which sound energy is transmitted through a unit area perpendicular to a specified point.

**3.1.1240 Sonic Flow** — A condition that occurs when flow of gas/vapor through a pressure relief device, piping or other equipment does not respond to a decrease in downstream or back pressure on the device. This usually occurs when the fluid velocity in the device equals the velocity of sound. The mass flow rate then depends only on upstream conditions.

**3.1.1241 Sorbent Tube** — A small glass tube normally filled with two layers of a solid sorbent material that will adsorb specific chemicals for subsequent elution and laboratory analysis.

**3.1.1242 Sour Gas** — Term used for natural gas or a gasoline contaminated with odor-causing sulfur compounds. In natural gas, the contaminant is usually hydrogen sulfide (H<sub>2</sub>S) and can be fatal in high concentrations; in gasoline, mercaptans are usually the source.

**3.1.1243 Source Model or Term** — A model used to determine the rate of discharge, the total quantity released (or total time) of a discharge of material from a process, and the physical state of the discharged material.

**3.1.1244 Source Modification** — Changing a hazard source to make it less hazardous (e.g., wetting dust particles or lowering the temperature of liquids to reduce off-gassing and evaporation).

**3.1.1245 Sas** — The concentration of a calibration gas mixture needed to span a desired concentration range of a chemical specific detector.

**3.1.1246 Span Vapor** — The concentration of a calibration vapor mixture needed to span a desired concentration range of a chemical specific detector.

**3.1.1247 *Splash-Proof Goggles*** — Eye protection constructed of noncorrosive material that fits snugly against the face and has indirect ventilation ports to protect against liquids that may inadvertently be directed to the eyes.

**3.1.1248 *Specification Standards*** — Description of the specific means of hazard abatement.

**3.1.1249 *Specificity (In Chemical Analysis)*** — The degree to which a given analytical procedure detects a specified component but not other components that may be present in the sample.

**3.1.1250 *Specific Burst Pressure*** — The specified burst pressure of a rupture disk device is the value of increasing inlet static pressure, at a specified temperature, at which a rupture disk device is designed to function.

**3.1.1251 *Spiked Sample*** — A normal sample of material (gas, solid or liquid) to which is added a known amount of some substance of interest. The extent of spiking is unknown to those analyzing the sample. Spiked samples are used to check on the performance of a routine analysis or the recovery efficiency of a method.

**3.1.1252 *Spill-Control-Centre*** — A collection of all the materials that are necessary to safely contain and control a spilled chemical and prepare it for safe disposal. Spillage kits, with instructions, appropriate absorbents and reactants, together with protective equipment, should be located in strategic positions around a work-area.

**3.1.1253 *Sprinkler System*** — A combination of water discharge devices (sprinklers), distribution piping to supply water to the discharge devices or more sources of water under pressure, water flow controlling devices (valves), and actuating devices (temperature, rate of rise, smoke, or other type device). The system automatically delivers and discharges water in the fire area.

**3.1.1254 *Spontaneously Combustible*** — Capable of igniting and burning in air without the presence of an ignition source. Pyrophoric materials are spontaneously combustible, although some pyrophorics require the presence of a minimum amount of moisture (humidity) to spontaneously ignite. Other spontaneously combustible substances and mixtures may require more time or an insulating environment to self-heat to the point of ignition.

**3.1.1255 *Spontaneous Ignition*** — Many substances combine with atmospheric oxygen at ordinary temperature and liberate heat. If the heat is liberated faster than it is dissipated, a fire can start. This process is called spontaneous ignition.

**3.1.1256 *Spot Cooling*** — Cooling the air of a limited portion of an enclosed space.

**3.1.1257 *Squeeze Bulb Pump*** — A sampling bulb that draws a fixed volume of air using a squeeze bulb.

**3.1.1258 *Stable Materials*** — Those materials that normally have the capacity to resist changes in their chemical composition, despite exposure to air, water, and heat as encountered in fire emergencies.

**3.1.1259 *Stabilizer*** — Substances, such as diphenylamine centralities which are added to explosives, such as nitrocellulose and nitroglycerine to prevent them from gradual decomposition due to storage. These additives neutralize the nitric acid produced thus preventing enhanced degradation rates.

**3.1.1260 *Stabilized*** — Containing a small amount of another substance included to keep the first material from changing form.

**3.1.1261 *Stack***

**3.1.1261.1 *A Structure*** that contains a flue, or flues, for the discharge of gases.

**3.1.1261.2** The vertical train of a system of soil, waste, or vent piping extending through one or more stories.

**3.1.1261.3** A device used to discharge air into the ambient environment and away from the building wake.

**3.1.1262 *Stack Sampling*** — A collection of aerosol samples in exhaust air ducts such as stacks or chimneys.

**3.1.1263 *Stagnation Pressure*** — Stagnation pressure is the pressure that would be observed if a flowing fluid were brought to rest along an isentropic path.

**3.1.1264 *Standard Trim Valve*** — A safety relief valve designed for compressible fluid service. With adjustable blow down, the valve can be set up for use with incompressible fluids.

**3.1.1265 *Static Pressure (SP) Loss*** — The amount of kinetic energy to overcome an obstruction or fitting in a ventilation system.

**3.1.1266 *Stationary Conditions*** — Conditions that are characterized by constant concentrations and temperatures as a function of time (i.e., the time derivatives are zero).

**3.1.1267 *Strength (acid/base)*** — The amount of ionization that occurs when an acid or a base is dissolved in liquid.

**3.1.1268 *Sublime*** — To change from a solid state to a gaseous state without becoming a liquid.

**3.1.1269** *Sub-iso-kinetic Sampling* — A sampling condition in which the air flowing into an inlet has a lower velocity than the ambient airflow. Subsequently, the sample collected tends to be biased with larger particles, substance, process, or work activity is utilized instead of a more dangerous one.

**3.1.1270** *Substrate Coating* — Materials that are applied onto certain substrates to capture or stabilize particles that are impacted during sampling.

**3.1.1271** *Superimposed Back Pressure* — The static pressure existing at the outlet of a safety relief device at the time the device is required to operate. It is the result of pressure in the discharge system from other sources.

**3.1.1272** *Super-iso-kinetic Sampling* — A sampling condition in which the air flowing into an inlet has a higher velocity than the ambient airflow. Subsequently, the sample collected tends to be biased with smaller particles.

**3.1.1273** *Supervised Area* — Any area not designated as a controlled area but for which occupational exposure conditions are kept under review even though specific protective measures and safety provisions are not normally needed.

**3.1.1274** *Supplemental Guarding* — Additional electro-sensitive safety devices and hard guarding measures used for the purpose of preventing a person from reaching over, under, or around the defined area of an installed safety light screen system and into the point of operation of the guarded machine.

**3.1.1275** *Supplied Air* — Breathable air supplied to a worker's mask/hood from a source outside the contaminated area.

**3.1.1276** *Supplied Air Suit* — A one- or two-piece suit that is impermeable to most particulate and gaseous contaminants and is provided with an adequate supply of respirable air.

**3.1.1277** *Supported Gloves* — Protective gloves that are constructed of a coated fabric to provide some rigidity.

**3.1.1278** *Synergistic Effect* — A synergistic effect is any effect of two chemicals acting together which is greater than a simple sum of their effects when acting alone.

**3.1.1279** *System Safety* — The application of operating, technical, and management techniques and principles to the safety aspects of a system throughout its life to reduce hazards to the lowest level possible through the most effective use of available resources.

**3.1.1280** *System Safety Analysis* — The hazard identification and evaluation of a complex process by means of a diagram or model that provides a comprehensive, overall view of the process, including its principal elements and the ways in which they are interrelated. There are four principal methods of analysis: failure mode and effect, fault tree, THERP, and cost-benefit analysis. Each has a number of variations, and more than one may be combined in a single analysis.

**3.1.1281** *System Safety Engineering* — The application of scientific and engineering principles during the design, development, manufacture, and operation of a system to meet or exceed established safety goals.

**3.1.1282** *System Safety Society* — A nonprofit organization organized in 1962 that is dedicated to supporting the safety professional in the application of Systems Engineering and Systems Management to the process of hazard, safety, and risk analysis to identify, assess, and control associated hazards while designing or modifying systems, products, or services.

**3.1.1283** *Systematic Failure* — A failure that happens in a deterministic (non-random) predictable fashion from a certain cause, which can only be eliminated by a modification of the design or of the manufacturing process, operational procedures, documentation, or other relevant factors. Since these are not mathematically predictable, the safety life cycle includes a large number of procedures to prevent them from occurring. The procedures are more rigorous for higher safety-integrity-level systems and components. Such failures cannot be prevented with simple redundancy.

**3.1.1284** *Systemic Risk* — The risk of an entire system, as opposed to risk associated with any one individual entity, group, or component of a system in contrast to a specific risk or unique risk. Systemic risk is a risk of security that cannot be reduced through diversification. Systemic risk evaluates the likelihood and degree of negative consequences to the larger body.

**3.1.1285** *Systemic Toxicity* — This term is applied when a substance affects a system in the organism other than and often distant from the site of application or exposure.

## T

**3.1.1286** *Target Zero* — A safety slogan or goal sometimes used in industry to highlight the measurement objective of no incidents for a particular reporting period. Its rationale is that you should never be planning to have an incident, and therefore your safety goal should always be zero.

**3.1.1287 Tautomerizing** — Converting from one isomer into one another in organic compounds that differ from one another in the position of a hydrogen atom and a double bond.

**3.1.1288 Technical Audits** — The examination of present status of health hazards.

**3.1.1289 Telltale** — A device used in sawmills to serve as a warning for overhead objects.

**3.1.1290 Tempered Glass** — A type of glass that has been treated to improve its stability and resistance to heat, impact, and distortion. Glass sheets are tempered at about 650 °C (1 200 °F) followed by a sudden chilling. This treatment increases the strength of the glass sheets approximately six times. When such glass does break (due to impact, expansion, etc.), it shatters into blunt granules to prevent injury instead of sharp-edged pieces.

**3.1.1291 Temperature**—Measure of the vibratory state of a molecule.

**3.1.1292 Temperature Actuated Pressure Relief Valve** — A pressure relief valve which is actuated by external or internal temperature.

**3.1.1293 Temperature of No Return** — The temperature at which the rate of heat generation of a reaction or decomposition is equal to the maximum rate of cooling available.

**3.1.1294 Thermal Conductivity** — The heat flow across a surface per unit area per unit time, divided by the negative of the rate of change of temperature with distance in a direction perpendicular to the surface.

**3.1.1295 Thermal Desorption** — The process of extracting adsorbed chemicals from sorbent material through the use of heat.

**3.1.1296 Thermal Drift** — Drift caused by an internal heating of equipment during normal operation or by changes in external ambient temperature.

**3.1.1297 Thermal Expansion** — The change in size of an object as the temperature changes. Normally, as the temperature increases, the size of an object also increases. Conversely, the object will shrink as the temperature drops. As an object expands or contracts with a temperature change, its change in length depends on three quantities: the original length, the temperature change, and the thermal properties of the material composing the object. When designing bridges, power lines, or similar items that might be subjected to wide temperature variations, engineers must take into account the effects of thermal expansion. Depending on the temperature range in a particular area, they may choose building materials that expand with heat or not,

different types of joint structures, and other kinds of reinforcements that might be required.

**3.1.1298 Thermal Effects on Safety Behavior** — The relationship between unsafe work behavior and ambient temperatures, described as a U-shaped curve, with the minimum unsafe behavior rate occurring in the preferred temperature zone of 17 °C (63 °F) to 23 °C (73 °F) wet bulb globe temperature (WBGT), and with the unsafe behavior rate increasing when ambient temperatures increase or decrease from this range.

**3.1.1299 Thermal Stress** — A combination of air temperature, radiant heat exchange, air movement, and the partial pressure of water vapor that makes the environment stressful.

**3.1.1300 Thermometer** — An instrument that measures temperature.

**3.1.1301 Theoretical Relieving Capacity** — The computed capacity expressed in gravimetric or volumetric units of a theoretically perfect nozzle having a minimum cross sectional flow area equal to the actual discharge area of a pressure relief valve or relief area of a non-reclosing pressure relief device. The flow path in a perfect nozzle is conventionally taken as isentropic.

**3.1.1302 Thermally Unstable** — A material that will undergo an exothermic, self-sustaining or accelerating self-reaction (decomposition, polymerization, or rearrangement) when heated to a specific temperature for given conditions of pressure, volume, composition, and containment. Thus, the self-reaction can be initiated by thermal energy alone.

**3.1.1303 Thermally-Broken-Down-Hazardous Waste** — Nonhazardous chemicals produced by heat treatment of waste.

**3.1.1304 Thermodynamic Instability** — Property of a chemical intermediate that causes it to break down, often with the release of energy leading to heat or explosion.

**3.1.1305 Time to Thermal Runaway** — An estimation of the time required for an exothermic reaction, in an adiabatic container, (that is, no heat gain or loss to the environment), to reach the point of thermal runaway.

**3.1.1306 Trans** — Referring to a particular arrangement of elements within a chemical molecule.

**3.1.1307 Trigger Event** — Normal event which, in combination with abnormal conditions, allows an incident to occur.

**3.1.1308 Time-Related Failure** — A failure that is primarily due to the degradation over the time that a device or system is in service. (Ex: the failure of a pump

after 2 000 hours of continuous service due to wear on the bearings would be considered a time-related failure).

**3.1.1309 *Time to Failure*** — The time period measure from the moment when equipment installation is complete to the equipment's inability to perform its duty or intended function.

**3.1.1310 *Time to Maximum Reaction Rate*** — The measured time to the maximum reaction rate during a runaway or rapid decomposition; the specific result is highly contingent on the test method used.

**3.1.1311 *Time-in-Service*** — Time from that moment when equipment installation is complete, the time period for equipment commissioning, and the operating time thereafter.

**3.1.1312 *Time-Varying Continuous Release*** — A subset of continuous release (*see* Continuous Release) that the release rate varies significantly with time.

**3.1.1313 *Time-Weighted Average (TWA)*** — The concentration of a substance to which a person is exposed in ambient air divided by the total time of observation. For occupational exposure a working shift of 8 hours is commonly used as the averaging time.

**3.1.1314 *Tolerance*** — An adaptive state characterized by diminished responses to the same dose of a chemical.

**3.1.1315 *Toll Processors*** — Contract chemical processors who produce material for a company.

**3.1.1316 *Tongs, Safety*** — A device for feeding small objects to and removing them from a danger area. It is typically a metal U-shaped tool that is used to grasp items with one hand.

**3.1.1317 *Toolbox Safety Meetings*** — Short on-the-job meetings in heavy industry and construction to keep employees apprised of work-related hazards. Their objective is to reinforce safety training and information on a particular topic. Employees are kept abreast of changes in regulations, safety procedures, equipment, personal protective equipment (PPE), and job assignments and responsibilities. They help employees to remember requirements, avoid risks, and prevent incidents.

**3.1.1318 *Toxicity*** — A relative property of a chemical agent, refers to a harmful effect on some biologic mechanism and condition under which the effect occurs.

**3.1.1319 *Toxic Dose*** — The combination of concentration and time for inhalation of a toxic gas that produces a specific harmful effect.

**3.1.1320 *Toxic Hazard*** — In the context of these guidelines, a measure of the danger posed to living organisms by a toxic agent, determined not only by the toxicity of the agent itself, but also by the means by which it may be introduced into the subject organisms under prevailing conditions.

**3.1.1321 *Toxico-kinetics*** — A term with the same meaning as chemo-bio-kinetics for substances not used as drugs.

**3.1.1322 *Toxicologic Effect*** — Harmful or poisonous effect of a chemical agent.

**3.1.1323 *Toxicology*** — Scientific study of poisons, their actions, their detection, and the treatment of conditions produced by them.

**3.1.1324 *Toxicometry*** — A combination of investigation methods and techniques for making a quantitative assessment of toxicity and hazards of poisons.

**3.1.1325 *Transport*** — The movement of chemicals within one environmental compartment or from one compartment to another.

**3.1.1326 *Transportation*** — The removal of wastes from a plant to an off-site location.

**3.1.1327 *Treated Filter*** — A filter that has been coated with a layer of chemical reagent to improve collection of specific chemicals for subsequent laboratory analysis.

**3.1.1328 *True Risk*** — The actual value of the risk level.

**3.1.1329 *Turbulent Flow*** — Chaotic flow with streamlines looping back on themselves; less —well-behaved and predictable than laminar flow.

**3.1.1330 *Turndown*** — An expression of the range of minimum and maximum flow rates expected under commonly encountered operating conditions. Commonly expressed as a ratio of minimum-to-maximum flow rate.

**3.1.1331 *Twin-Detector Tube*** — A detector tube construction consisting of a combination of a pretube and an indicating tube, joined by an intermediate sleeve and a piece of shrunk-on tubing.

## U

**3.1.1332 *Ultimate Load*** — The minimum applied force necessary to cause failure of a material.

**3.1.1333 *Ultimate Stress*** — The intensity of stress at the point of failure for a material.

**3.1.1334** *Ultrasonic Testing* — A type of nondestructive testing of materials using high frequency sound, which is used to check for defects and flaws.

**3.1.1335** *Unattended Operation* — The practice of leaving equipment to run outside normal working hours; such equipment should be fitted with suitable fail-safe devices.

**3.1.1336** *Unavailability* — The probability the fault event exists at a specified time.

**3.1.1337** *Unconfined Vapor Cloud Explosion (UCVE)* — Explosive oxidation of a vapor cloud in a unconfined space (i.e., not in vessels, buildings, etc.). The flame speed may accelerate to high velocities and produce significant blast overpressure. Vapor cloud explosions in densely packed plant areas (pipe lanes, units, etc.), may show accelerations in flame speeds and intensification of blast.

**3.1.1338** *Undependability* — The probability the fault event exists at a specified time or occurs during a specified time interval.

**3.1.1339** *Undeveloped Event* — A base event that is not developed because of insufficient consequence or because information is unavailable.

**3.1.1340** *Unreliability* — The probability that the fault event occurs during a specified time interval.

**3.1.1341** *Unsafe Condition* — Any omission of a safe practice or safe working condition that increases hazard or risk.

**3.1.1342** *Unstable* — Tending toward decomposition or other unwanted chemical change during normal handling or storage.

**3.1.1343** *Unstable Material* — A material that, in the pure state or as commercially produced, will vigorously polymerize, decompose or condense, become self-reactive, or otherwise undergo a violent chemical change under conditions of shock, pressure, or temperature.

**3.1.1344** *Unsupported Gloves* — A type of protective, unlined glove without any type of fabric lining to provide internal support to the glove.

**3.1.1345** *Upper Explosive Limit (UEL) or Upper Flammable Limit (UFL)* — The highest concentration of a vapor or gas (the highest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. *see* also lower explosive limit or lower flammable limit.

NOTE — At concentrations higher than the UEL the mixture is too rich to burn.

**3.1.1346** *Urticaria* — An allergic reaction that results in raised bumps on the skin and mucous membranes. It is usually accompanied by itching. It is an allergen to food, plant inhalants (e.g., pollen), or chemicals.

## V

**3.1.1347** *Vacuum Distillation* — Distillation under reduced pressure to achieve a low boiling point and reduce thermal degradation.

**3.1.1348** *Vacuum Relief Valve* — A pressure relief device designed to admit fluid to prevent an excessive internal vacuum; it is designed to reclose and prevent further flow of fluid after normal conditions have been restored.

**3.1.1349** *Vacuum Support* — An auxiliary element of a rupture disk device designed to prevent rupture or deformation of the disk due to vacuum or reversal of pressure.

**3.1.1350** *Valve Bonnet* — The housing around the spring of an enclosed-spring pressure relief valve.

**3.1.1351** *Vaporization* — Volatilization of a liquid at temperatures below the boiling point.

**3.1.1352** *Vapors* — Molecules of liquid in air; moisture such as steam, fog, mist etc, often forming a cloud suspended or floating in the air, usually due to the effect of heat upon a liquid.

**3.1.1353** *Vapor Density* — The weight of a vapor or gas compared to the weight of an equal volume of air, an expression of the density of the vapor or gas. Materials lighter than air have vapor densities less than 1.0 (example: acetylene, methane, hydrogen). Materials heavier than air (examples: propane, hydrogen sulfide, ethane, butane, chlorine, sulfur dioxide) have vapor densities greater than 1.0. Importance: All vapors and gases will mix with air, but the lighter materials will tend to rise and dissipate (unless confined). Heavier vapors and gases are likely to concentrate in low places along or under floors, in sumps, sewers and manholes, in trenches and ditches—and can travel great distances undetected where they may create fire or health hazards.

**3.1.1354** *Vapor Pressure* — The pressure exerted by a vapor above its own liquid.

NOTE — The higher the vapor pressure, the easier it is for a liquid to evaporate and fill the work area with vapors which can cause health or fire hazards.

**3.1.1355** *Virtual Source* — The offset in distance to the specified source of a gas or vapor release that results in a maximum concentration of 100 % at the source using a Gaussian dispersion model.

**3.1.1356 Viscosity** — The measurement of the flow properties of a material expressed as its resistance to flow. Unit of measurement and temperature are included.

**3.1.1357 Venting** — Flow of vessel contents out the vessel. The pressure is reduced by adequate venting, thus avoiding a failure of the vessel by over pressurization. The emergency flow can be one-phase or multiphase, each of which results in different flow and pressure characteristics.

**3.1.1358 Ventilation System** — A means of supplying fresh air to and disposing of used air from the laboratory environment.

**3.1.1359 Vessel Neck** — A piping connection on a vessel, also referred to as a — vessel nozzle. Commonly constructed of a short section of pipe welded to the vessel, and with either a flanged or threaded end for connecting piping or instrumentation.

**3.1.1360 Violent Reaction** — The action by which a chemical changes its composition near or exceeding the speed of sound, often releasing heat and gases.

**3.1.1361 Viscosity** — The tendency of a fluid to resist internal flow without regard to its density.

**3.1.1362 Volatile** — Easily changes from a liquid to a vapor.

**3.1.1363 Volatile Organic Compound** — Any organic compound that participates in atmospheric photochemical reactions.

**3.1.1364 Volatility**

**3.1.1364.1** The tendency or ability of a liquid to vaporize. Such liquids as alcohol and gasoline, because of their well-known tendency to evaporate rapidly, are called volatile liquids.

**3.1.1364.2** A measure of how quickly a substance forms a vapor at ordinary temperatures.

**3.1.1365 Vortex Coolers** — An open loop system in which both a hot and cold stream of air from a compressed air source is generated.

## W

**3.1.1366 Walk Through Survey** — A physical safety inspection of the workplace to identify and evaluate potential hazards.

**3.1.1367 Water Reactive Chemical** — A compound or element that reacts rapidly or violently with water.

**3.1.1368 Water Solubility** — The ability of a substance to mix with water.

**3.1.1369 Warning** — Communication and acknowledgment of dangers, such as operating procedures, practices, or conditions that may result in injury or damage if not carefully observed or followed.

**3.1.1370 Warning Sign** — An advisory or statutory sign that identifies a chemical, physical or other hazard.

**3.1.1371 Warning Signal** — Typically means an auditory alarm (e.g., siren) or visual indication (e.g., flashing lights) to warn of a hazard aspect occurring over a wide area (e.g., toxic gas release in a chemical plant; tsunami approach etc.) and the need for immediate actions to prevent injury or damage (e.g., evacuation, shelter in place, etc.). The effectiveness of signal is dependent on its capability to be observed, the population's awareness of the signal characteristics, and the actions to be taken upon its activation.

**3.1.1372 Warning Tag** — Warning tags are used to represent a hazard level between caution and danger.

**3.1.1373 Wet Bulb Globe Temperature (WBGT)**

**3.1.1373.1** The combination of the effect of the four main thermal components affecting heat stress: air temperature, humidity, air velocity and radiation, as measured by the dry bulb (Tdb), natural wet bulb (Tnwb) and globe temperatures (Tg).

**3.1.1373.2** Temperatures calculated as the sum of 0.7 natural wet bulb + 0.2 black globe + 0.1 dry bulb.

**3.1.1374 Wet Kata Thermometer** — A thermometer where the bulb converted by a wetted wick and heated in water and then allowed to cool in the environment being measured. The time required for the liquid in the wet kata to cool between the two marks can be measured with a stop watch, and this time can be used with a calibration sheet to determine the cooling power of the air.

**3.1.1375 What-If Analysis (WIA)** — A safety review method by which What-If investigative questions (i.e., brainstorming or checklist approach) are asked by an experienced and knowledgeable team of the system or component under review where there are concerns about possible undesired events. Recommendations for the mitigation of identified hazards are provided.

**3.1.1376 Witness** — A person who has information related, directly or indirectly, to the accident or incident.

**3.1.1377 Working Occupational Exposure Limit** — An informal occupational exposure limit set by a occupational hygienist based on whatever information may be available to differentiate acceptable from unacceptable exposures. Working OEL's are sometimes stated in ranges (e.g., 0.1 mg/m<sup>3</sup> to 1.0 mg/m<sup>3</sup>) or incorporate large safety factors to account for uncertainty.

**3.1.1378 Workplace Exposure Assessment** — The exposure characterization of the worker's potential exposure to hazardous chemical, physical or biological agents. The information included should include the agents, their likely routes of exposure, and intensity, duration, and frequency of the exposure.

**3.1.1379 Workplace Safety Program** — A program that aims to develop a long-term plan that is successful in protecting people from injury and death, that complies with regulations, and that controls the associated financial costs of loss.

**3.1.1380 Worst Case Consequence** — A conservative (high) estimate of the consequences of the most severe accident identified. For example, the assumption that the entire contents of a contained volume of toxic material is released to the most vulnerable area in such a way (all at once or continuous) as to have the maximum effect on the public or employees in that area. The contained volume could be chosen as the containers and pipes between shutoff valves or the entire process unit but probably not the entire plant.

**3.1.1381 Worst-Case-Scenario** — A method of conducting an exposure assessment in which the most conservative value of each input parameter is selected.

**3.1.1382 Worst Credible Incident** — Hypothesized incident requiring the largest pressure relief device, that is considered plausible or reasonably believable.

**3.1.1383 Worst Possible Incident** — The most severe incident, considering only incident outcomes and their consequences, of all identified incidents and their outcomes.

## X

**3.1.1384 Xenobiotic** — A chemical which is not natural component of the organism exposed to it.

## Z

**3.1.1385 Zero Gas** — A gas containing less than 1 ppm sulfur dioxide.

**3.1.1386 Zero Mechanical State** — The mechanical potential energy in all elements of a machine or piece of equipment is dissipated, so that opening or activation of any device will not produce a movement that could cause injury.

## 4 RADIATION HAZARDS

### A

**4.1 Absorbed Dose** — The fundamental dosimetric quantity,  $D$  defined as

$$D = dE / dm,$$

where,  $dE$  is the mean energy imparted by ionizing radiation to matter in a volume element, and  $dm$  is the mass of matter in the volume element. The energy can be averaged over any defined volume, the average dose being equal to the total energy imparted in the volume divided by the mass in the volume. The SI unit of absorbed dose is joule per kilogram (J/kg) termed as Gray (Gy) (formerly rad was used as the unit of absorbed dose). Absorbed dose is defined at a point and for average dose in tissues/organs, new unit organ dose is defined.

**4.2 Activation** — The process of inducing radioactivity.

NOTE — This word is most commonly used to refer to the induction of radioactivity in moderators, coolants and structural and shielding materials, caused by irradiation with neutrons.

**4.3 Activity or Radioactivity** — The emission of ionizing radiation or particles caused by the spontaneous disintegration of atomic nuclei. The quantity 'A', which represent activity for an amount of radionuclide in a given energy state at a given time is defined as:

$$A = dN/dt$$

where

$dN$  is the expectation value of the number of spontaneous nuclear transformations from the given energy state in a time interval  $dt$ . The SI unit of activity is the reciprocal of second ( $s^{-1}$ ), termed the Becquerel (Bq).

**4.4 Action levels** — The level of dose rate or activity concentration above which remedial actions or protective actions should be carried out in chronic exposure or emergency exposure situations. An action level can also be expressed in terms of any other measurable quantity as a level above which intervention should be undertaken.



**4.5 Acute exposure**—Exposure received within a short period of time.

NOTE — Normally used to refer to exposure of sufficiently short duration that the resulting *doses* can be treated as instantaneous (e.g. less than an hour).

**4.6 Airdose** — X-ray dose expressed in roentgens delivered at a point in free air. In radiological practice it consists of the dose due to the radiations of the primary beam and to that scattered from surrounding air.(Also *see* kerma)

**4.7 ALARA** — An acronym for As Low As Reasonably Achievable. A concept meaning that the design and use of sources, and the practices associated therewith, should be such as to ensure that exposures are kept as low as reasonably practicable, with economic and social factors taken into account. The term ALARA should not be used to mean optimization of protection and safety.

**4.8 Alpha-Particle ( $\alpha$ -Particle)** — A helium nucleus (consisting of two protons and two neutrons) having a mass of 4 units and 2 units of positive charge. It is a fundamental particle.

**4.9 AMAD** — Activity Median Aerodynamic Diameter — The value of aerodynamic diameter such that 50 percent of the airborne activity in a specified aerosol is associated with particles smaller than the AMAD, and 50 percent of the activity is associated with particles larger than the AMAD. AMAD is used for particle sizes for which deposition depends principally on internal impaction and sedimentation i.e. typically those greater than about 0.5  $\mu\text{m}$ .

**4.10 Ambient dose equivalent,  $H^*(d)$**  — *see* Dose equivalent quantities.

**4.11 Annual dose** — The dose due to external exposure in a year plus the committed dose from intakes of radionuclides in that year.

**4.12 Annual Limit on Intake (ALI)** — The intake by inhalation, ingestion or through the skin of a given radionuclide in a year by the reference man, which would result in a committed dose equal to the relevant dose limit. The ALI is expressed in units of activity (Bq).

**4.13 Atmospheric dispersion** — The spreading of radionuclides in air resulting from physical processes viz. advection, diffusion etc. affecting the velocity of different molecules in the medium.

**4.14 Attenuation** — The reduction in intensity of radiation passing through matter due to processes like absorption and scattering.

**4.15 Attenuation Factor** — The ratio of the incident intensity of a beam of radiation to the transmitted intensity.

**4.16 Autoradiograph** — A self portrait of the radioactive material in an object made by placing the object close to photographic plates or films which are then developed.

**4.17 Averted dose** — The dose prevented by the application of a countermeasure or set of countermeasures, i.e. the difference between the projected dose if the countermeasure(s) had not been applied and the actual projected dose.

## B

**4.18 Background Radiation** — The dose or dose rate attributable to all sources other than a specified one. The natural background dose/dose rate or activity concentration associated with natural sources or any other sources in the environment that are not amenable to control.

**4.19 Becquerel (Bq)** — The SI unit of activity, equal to one transformation per second. This supersedes the non-SI unit curie (Ci).

$$1\text{ Bq} = 2.7 \times 10^{-11} \text{ Ci (approximately)} \quad 1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq.}$$

**4.20 Beta-Particle ( $\beta$ -Particle)** — Charged particle, emitted from the nucleus of an atom and having a mass and charge equal in magnitude to those of the electron. (*see* also positron)

**4.21 Bioassay** — Any procedure used to determine the nature, radioactivity, location or retention of radionuclides in the body by direct (in vivo) measurement or by in vitro analysis of material.

**4.22 Biological half-life** — The time taken for the quantity of a material in a specified tissue, organ or region of the body (or any other specified biota) to decrease by half as a result of biological processes.

**4.23 Bremsstrahlung** — Electromagnetic radiation resulting from interaction between two charged particles (usually an electron and a nucleus), in the form of emission of continuous X-rays.

## C

**4.24 Characteristic (Discrete) Radiation** (or characteristic X-rays) — X-radiation consisting of discrete wavelengths which are characteristic of the emitting element.

**4.25 Chronic exposure** — Radiation exposures received over a prolonged duration of time. The adjective chronic relates only to the duration of exposure and does not imply anything about the magnitude of the doses involved.

#### 4.26 Clearance

**4.26.1** Removal of radioactive material or radioactive objects within authorized practices from any further regulatory control by the regulatory body.

**4.26.2** The net effect of biological processes by which radionuclides are removed from a tissue, organ or area of the body. The *clearance rate* is the rate at which this occurs.

**4.27 Clearance level** — A value, established by a regulatory body and expressed in terms of activity. Concentration and/or total activity, at or below which a source of radiation may be released from regulatory control.

**4.28 Collective Dose** — The total dose incurred by a population and the unit is man-Sv. An expression for the total radiation dose incurred by a population and defined as the product of the number of individuals exposed to a source and their average radiation dose.

**4.29 Committed Dose** — The lifetime dose expected to result from an intake of radioactivity. The time period is generally taken as 50 years for adults and 70 years for infants.

**4.30 Committed Effective Dose,  $E(\tau)$**  — The time integral of the whole body effective dose rate following an intake of a radionuclide. The quantity  $E(\tau)$  is defined as:

$$E(r) = \sum w_T H_T(r) T$$

where

$H_T(\tau)$  is the committed equivalent dose to tissue T over the integration time  $\tau$  and  $w_T$  is the tissue weighting factor for tissue T.

When  $\tau$  is not specified, it will be taken to be 50 years for adults and the time to age 70 years for intakes by children.

**4.31 Containment** — Methods or physical structures designed to prevent or control the release and the dispersion of radioactive substances.

**4.32 Contamination** — Radioactive substances on surfaces, or within solids, liquids and gases (including the human body) where their presence is unintended or undesirable or the process giving rise to their presence in such places.

**4.33 Controlled Area** — A delineated area to which access is controlled and in which specific protection measures and safety provisions are, or could be, required for

- controlling normal exposures or preventing the spread of contamination during normal working conditions; and
- preventing potential exposures or limiting their extent should they occur.

**4.34 Countermeasure** — An action aimed at alleviating the radiological consequences of an accident. Counter measures are forms of intervention and may be protective actions or remedial actions.

**4.35 Critical group** — A group of members of the public which is reasonably homogeneous with respect to its exposure for a given radiation source and is typical of individuals receiving the highest effective dose or equivalent dose from the given source.

**4.36 Criticality** — The state of a nuclear chain reacting medium when the chain reaction is just self-sustaining (or critical) i.e. when the reactivity is zero.

**4.37 Curie** — The unit of radioactivity. It is the quantity of a radioactive isotope which disintegrates at the rate of 37 000 millions disintegrations per second. The activity of a gram of radium is approximately equal to one curie.  $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$  (exactly)

## D

**4.38 Daughter** — A synonym for Decay Product.

**4.39 Decay Constant** — The constant ratio for the number of atoms of a radionuclide that decay in a given period of time compared with the total number of atoms of the same kind present at the beginning of that period. It is also called as disintegration constant.

**4.40 Decay Product** — A nuclide resulting from the radioactive disintegration of a radio nuclide, formed either directly or as a result of successive transformations in a radioactive series. A decay product may be either radioactive or stable.

**4.41 Decay, Radioactive** — Radioactive decay is the process whereby a radionuclide is transformed into a nuclide of another element as a result of the emission of radiation from its nucleus. The radioactive decay equation is

$$N(t) = N_0 e^{-0.693t/t_{1/2}}$$

where  $N_0$  is the initial quantity of the substance  $N(t)$  is the quantity that still remains and has not yet decayed after a time  $t$ ,  $t_{1/2}$  is the half life of the decaying quantity,  $e$  = Euler's number = 2.718 281 828 459 045 904 523 536 028 747 135 27

**4.42 Decontamination Factor** — Ratio of the initial concentration of contaminating radioactive material to the final concentration after a separation process. The ratio of activity per unit area (or per unit mass or volume) before a particular decontamination technique is applied to the ratio of activity per unit area (or per unit mass or volume) after application of the technique.

**4.43 Derived Air Concentration (DAC)** — A derived limit on the activity concentration in air of a specified radionuclide. The limit has been calculated such that the Reference Man breathing air with constant contamination at the DAC while performing light physical activity for a working year, would receive an intake corresponding to the annual limit on intake for the radionuclide in question.

The parameter values recommended for calculating DACs are a breathing rate of 1.2 m<sup>3</sup>/h and a working year of 2 000 h.

**4.44 Detection limit** — *see* MDA

**4.45 Deterministic Effects** — A health effect of radiation for which generally a threshold level of dose exists, above which the severity of the effect is greater for a higher dose.

**4.46 Directional dose equivalent  $H'(d, \Omega)$**  — *see* Dose equivalent quantities.

**4.47 Discharge** — Planned and controlled release of radioactive material (usually gaseous or liquid) radioactive material to the environment, in accordance with an authorization.

**4.48 Disintegration, Nuclear** — *see* Decay, Radioactive.

**4.49 Dose** — A measure of energy deposited by radiation in a target. The quantities termed absorbed dose, organ dose, equivalent dose, effective dose, committed equivalent dose, or committed effective dose are used, depending on the context. The modifying terms are used when they are not necessary for defining the quantity of interest. (*see* also Annual dose, Averted dose, Effective dose, Equivalent dose, Collective dose, committed dose, Life time dose, projected dose)

#### 4.50 Dose Equivalent Quantities

**4.50.1 Ambient dose equivalent,  $H^*(d)$**  — The dose equivalent that would be produced by the corresponding aligned and expanded field in the ICRU

*sphere* at a depth  $d$  (10 mm for strongly penetrating radiation) on the radius opposing the direction of the aligned sphere. It is a parameter defined at a point in a radiation field and can be used as a directly measurable substitute for effective dose for use in monitoring of external exposure.

**4.50.2 Directional dose equivalent  $H'(d, \Omega)$**  — The dose equivalent that would be produced by the corresponding expanded field in the ICRU sphere at a depth  $d$  on a radius in a specified direction  $\Omega$ . This parameter is defined at a point in a radiation field. Used as a directly measurable proxy for equivalent dose in the skin for use in monitoring of external exposure. The recommended value of  $d$  is 0.07 mm for weakly penetrating radiation.

**4.50.3 Personal dose equivalent,  $H_p(d)$**  — The dose equivalent in soft tissue below a specific point on the body at an appropriate depth  $d$ . The recommended values of  $d$  are 10 mm for strongly penetrating radiation and 0.07 mm for weakly penetrating radiation.

**4.51 Dose Limit** — The value of the effective dose or the equivalent dose to individuals from controlled practices that shall not be exceeded.

**4.52 Dose Rate** — Radiation dose delivered per unit time.

**4.53 Dose coefficient** — Radiation dose per unit intake of radioactivity.

**4.54 Dosimeter** — Instrument used to detect and measure an accumulated dose of radiation; in common usage it is a pencil size ionization chamber with built in self-reading electrometer, used for personnel monitoring.

## E

**4.55 Electron Capture** — A mode of radioactive decay involving the capture of an orbital electron by its nucleus. The mode is further designated as K-electron capture, L-electron capture, etc., depending on whether the capture is from the K-shell, or L-shell, etc. This is followed by emission of X-rays.

**4.56 Enriched Material** — Material in which the relative amount of one or more isotopes of a constituent has been increased, such as enriched uranium, in which the abundance of U-235 isotope is increased above natural composition.

**4.56 Entrance Surface Dose** — Absorbed dose in the centre of the field at the surface of entry of radiation for a patient undergoing a radio diagnostic examination, expressed in air and with backscatter.

**4.57 Effective Half-life ( $T_{\text{eff}}$ )** — The time taken for the activity of a radionuclide in a specified place to half of the initial activity as a result of all relevant processes.

$$\frac{1}{t_{\text{eff}}} = \sum_0^i 1/t_i$$

where,  $T_i$  is the half-life for process  $i$ .

**4.58 Effective Dose,  $E$**  — The quantity  $E$ , defined as a summation of the equivalent doses, each multiplied by the appropriate tissue weighting factor.

$$E = \sum_T w_T H_T$$

where,  $H_T$  is the equivalent dose in tissue  $T$  and  $w_T$  is the tissue weighting factor for tissue  $T$ .

From the definition of equivalent dose, it follows that:

$$E = \sum_T w_T \sum_R w_R D_{T,R}$$

where,  $w_R$  is the radiation weighting factor for radiation  $R$  and  $D_{T,R}$  is the average absorbed dose in the organ or tissue  $T$ . The unit of effective dose is *sievert* (Sv) equal to 1 J/kg.

**4.59 Emergency** — A non-routine situation that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human health and safety, quality of life, property or the environment. This includes nuclear and radiological emergencies and conventional emergencies such as fires, release of hazardous chemicals, storms or earthquakes. It includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard.

**4.59.1 Nuclear or radiological emergency:** An emergency in which there is, or is perceived to be, a hazard due to:

- a) The energy resulting from a nuclear chain reaction or from the products of decay of the products of chain reaction; and
- b) Radiation exposure.

**4.59.2 Emergency Worker** — A worker who may be exposed in excess of occupational dose limits while performing actions to mitigate the consequences of an emergency for human health and safety, quality of life, property and the environment.

**4.60 Equilibrium, Radioactive** — The state of a radioactive decay chain (or part thereof) where the activity of each radionuclide in the chain (or part of the chain) is the same. This state is achieved when the

parent nuclide has a much longer half-life than the progeny, and after a time equal to several times the half-life of the longest lived of the progeny.

**4.61 Equilibrium Equivalent Concentration** — The activity concentration of radon or thoron in radioactive equilibrium with its short lived progeny that would have the same potential alpha energy concentration as the actual (non-equilibrium) mixture.

The unit of equivalent dose is sievert (Sv) equal to 1 J/kg.

**4.62 Evacuation** — The rapid, temporary removal of people from an area to avoid or reduce short term radiation exposure in an emergency.

**4.63 Exemption** — The determination by a regulatory body that a source or practice need not be subject to some or all aspects of regulatory control on the basis that the exposure including potential exposure due to the source or practice is too small to warrant the application of those aspects or that this is the optimum option for protection irrespective of the actual level of the doses or risks.

**4.64 Exposure** — The act or condition of being subject to irradiation. Exposure can be either *external* (irradiation by sources outside the body) or *internal* (irradiation by sources inside the body). Exposure can be classified as either *normal exposure* or *potential exposure*; either *occupational, medical or public exposure*; and in intervention situations, either emergency exposure or chronic exposure. The term exposure is also used in radiation dosimetry to express the amount of ions produced in air by ionising radiation.

**4.65 Exposure Pathway** — The routes by which radioactive material can reach or irradiate humans.

**4.66 External Radiation** — That radiation reaching a given point in the body or the material which is directly or indirectly due to a source of radiation outside the body of material.

## F

**4.67 Fertile** — Fertile materials are materials that can undergo transmutation to become fissile materials. Thorium-232 and Uranium-238 are two fertile nuclides which can produce fissile uranium-233 and plutonium-239 respectively.

**4.68 Filter, Primary (Radiology)** — A sheet of material usually metal, placed in the path of a beam of radiation to remove as far as possible the less penetrating components.

**4.69 Filter, Secondary (Radiology)** — A sheet of material of lower atomic number relative to that of the primary filter placed in the path of the filtered beam of radiation to remove characteristic radiation produced by the primary filter.

**4.70 Fissile** — Nuclides capable of undergoing fission by interaction with thermal neutrons.

**4.71 Fissile material** — Uranium-233, Uranium-235, Plutonium-239, Plutonium-241 or any combination of these radionuclides.

**4.72 Fission** — The splitting of a heavy nucleus into two (or very rarely more) approximately equal fragments, fission fragments. Fission is accompanied by the emission of neutrons and the release of energy. It can be spontaneous or it can be caused by the interaction of neutrons, or fast charged particles or high energy proton.

**4.73 Fissionable** — Nuclides that are capable of undergoing fission.

## G

**4.74 Gamma Ray ( $\gamma$  -Ray)** — Electro-magnetic radiation emitted by the nuclei of radioactive substances during decay.

**4.75 Gas Flow Counter** — A counter (for measuring radioactivity) in which an appropriate atmosphere is maintained in the counter tube by allowing a suitable gas to flow slowly through the sensitive volume.

**4.76 Geiger Muller Counter** — Highly sensitive gas filled device for counting photons or charged particles by means of ionization they produce in a gas.

**4.77 Geiger Region** — The operation voltage interval in an ionization detector, in which the charge collected per ionizing event is essentially independent of the number of primary ions produced in the initial ionizing event.

**4.78 Gray** — The SI unit of absorbed dose. One Gray is equal to 1 joule per kilogram. 1 Gy = 1 J/kg.

## H

**4.79 Half-Life (Biological)** — The time required for the body to eliminate one half of an administered dose of any substance by regular process of elimination. This time is approximately the same for both stable and radioactive isotopes of a particular element.

**4.80 Half-Life (Effective)** — Time required for a radioactive element absorbed in the tissue of an animal body to be diminished by half as a result of the combined action of radioactive decay and biological elimination.

Effective half-life = Biological half-life  $\times$  Physical half-life  
Biological half-life + Physical half-life

**4.81 Half-Life (Physical)** — The time taken for the activity of a radioactive substance to decay to half its original value, that is, for half the atoms present to

disintegrate. Also termed Half-Life, Radioactive, or merely half-life.

**4.82 Half-Value Layer** — The thickness of any particular material necessary to reduce the intensity of an X-ray or  $\gamma$ -ray beam to one-half its original value

**4.83 Health Physics** — The branch of radiological science dealing with the protection of personnel from harmful effects of ionizing radiation.

## 4.84 Health Effects (of Radiation)

**4.84.1 Early Effect** — A radiation induced health effect that occurs within months of the exposure that caused it. All early effects are deterministic effects. But, not all deterministic effects are early effects.

**4.84.2 Hereditary Effect** — A radiation induced health effect that occurs in a descendant of the exposed person. These effects are usually stochastic effects.

**4.84.3 Late Effects** — A radiation induced health effect that occurs years after the exposure that caused it. The most common late effects are stochastic effects such as leukaemia and solid cancers, but some deterministic effects like cataract formation can also be late effects.

**4.84.4 Somatic Effect** — A radiation induced health effect that occurs in the exposed person.

**4.84.5 Stochastic Effect** — A radiation induced health effect, the probability of occurrence of which is greater for a higher radiation dose and the severity of which is independent of dose.

**4.85 Hold Back Carrier** — The inactive isotope or isotopes of a radioactive element of similar properties, or some reagent, which may be used to diminish the amount of a radionuclide co-precipitated or absorbed in a chemical reaction.

## I

**4.86 ICRU** — A sphere of 30 cm diameter made of tissue equivalent material with a density of 1 g/cm<sup>3</sup> and a mass composition of 76.2 percent oxygen, 11.1 percent carbon, 10.1 percent hydrogen and 2.6 percent nitrogen. It is used as a reference phantom in defining dose equivalent quantities.

**4.87 Induced Radioactivity** — Radioactivity caused in a substance after bombardment with neutrons, charged particles,  $\gamma$ -rays etc.

**4.88 INES** — A simple scale, designed for promptly communicating to the public in consistent terms the safety significance of events at nuclear facilities. The scale ranges from 0 to 7.

**4.89 Intake** — The process of taking radionuclide into the body by inhalation or ingestion, or through the skin. It also refers to the activity of a given radionuclide taken into the body in a given time period or as a result of a given event.

**4.90 Initiating event** — An identified event that leads to anticipated operational occurrences or accident conditions.

**4.91 Integral Dose** — A measure of the total energy absorbed by a patient or any object during exposure to radiation. According to British usage the integral dose of X-rays or  $\gamma$ -rays is expressed in gram-roentgens.

**4.92 Internal Conversion** — A transition between two energy states of a nucleus where the energy difference is not emitted as a photon (gamma ray) but is given to an orbital electron in the K or L-shell which is thereby ejected from the atom.

**4.93 Internal Radiation Hazard** — Possible adverse health conditions attributable to radiation damage to an individual from internally deposited radioactive materials.

**4.94 Intervention** — Any action intended to reduce or avert exposure or its likelihood to sources which are not a part of controlled practice or which are out of control as a consequence of an accident.

**4.95 Investigation Level** — The value of a quantity such as effective dose, intake or contamination per unit area or volume at or above which an investigation could be conducted.

**4.96 Iodine Prophylaxis** — The administration of a compound of stable iodine (usually potassium iodide) to prevent or reduce the uptake of radioactive isotopes of iodine by the thyroid in the event of an accident involving radioactive iodine.

**4.97 Ionization Chamber** — A device designed to measure the quantity of ionizing radiation in terms of the charge of electricity associated with ions produced in a defined volume.

**4.98 Ionizing Radiation** — Any electro-magnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.

**4.99 Irradiation** — The exposure of materials to radiation.

**4.100 Isobar** — One of two or more different nuclides having the same mass number.

**4.101 Isomer** — One of two or more different nuclides having the same mass number, and the same atomic number but differing radioactive properties such as

different half-lives due to difference in energy levels and to the possibility of different decay patterns.

**4.102 Isomeric Transition (IT)** — The process by which a nuclide decays to an isomer of a lower energy state.

**4.103 Isotone** — One of two or more nuclides having the same number of neutrons in their nuclei.

**4.104 Isotope** — One of two or more nuclides having the same number of protons in their nuclei, and hence having the same atomic number, but differing in the number of neutrons and hence in the mass number or in energy content (isomers). Almost identical chemical properties exist between isotopes.

## J

**4.105 Justification** — The process of determining whether a practice is overall, beneficial, as required by the International Commission on Radiological Protection's System of Radiological Protection, i.e. whether the benefits of individuals and to society from introducing or continuing the practice outweigh the harm (including radiation detriment) resulting from the practice.

## K

**4.106 K-Capture** — A common term for capture of an electron from K-shell of an atom by the nucleus (a mode of radioactive decay). (*see also* electron capture).

**4.107 Kerma, K** — The quantity K, defined as:

$$K = \frac{dE_{tr}}{dm}$$

where  $dE_{tr}$  is the sum of the initial kinetic energies of all charged ionizing particles liberated by uncharged ionizing particles in a material of mass  $dm$ . The unit for kerma is Gray (Gy).

## L

**4.108 Labelled Compound** — A compound consisting in part of labeled molecules (*see* Labelled Molecule).

**4.109 Labelled Molecule** — A molecule containing one or more atoms, radioactive or stable, characterized by non-natural isotopic composition.

**4.110 Lead Equivalent** — The thickness of lead affording the same reduction in radiation dose rate under specific conditions as the material in question.

**4.111 Leakage Radiation** — Radiation coming out of the source/tube housing, except the useful beam or primary beam.

**4.112 License** — A legal document issued by the regulatory body granting authorization to perform specified activities related to a facility or activity is called as licence. The holder of a current licence is termed a licensee.

**4.113 Lifetime Dose** — The total dose received by an individual during his or her lifetime. In practice, this is approximated as the sum of the annual doses incurred. For prospective assessments of lifetime dose, a lifetime is normally interpreted as 70 years.

**4.114 Linear Energy Transfer (LET),  $L_{\Delta}$**  — It refers to a measure of how energy is transferred from radiation as a function of distance in any single collision. It is defined generally as:

$$dE L_{\Delta} = \left( \frac{dE}{dl} \right)_{\Delta}$$

where  $dE$  is the energy lost in traversing distance  $dl$  and  $\Delta$  is an upper bound on the energy transferred in any single collision. It is expressed in units of kilo electron volts per micron (keV/ $\mu$ m).

**4.115 Low Enriched Uranium (LEU)** — Enriched uranium containing less than 20 percent of the isotope  $^{235}\text{U}$ . LEU is considered a special fissionable material and an indirect use material.

## M

**4.116 Minimum Detectable Activity (MDA)** — The radioactivity which, if present in a sample, produces a counting rate that will be detected (i.e. considered to be above background) with a certain level of confidence, normally set at 95 percent. This means, a sample containing exactly the minimum detectable activity will, as a result of random fluctuations, be taken to be free of radioactivity 5 percent of the time. Minimum detectable activity is sometimes referred to as the Detection limit.

**4.117 Medical exposure** — Exposure incurred by patients as part of their own medical or dental diagnosis (diagnostic exposure) or treatment (therapeutic exposure); by persons, other than those occupationally exposed, knowingly while voluntarily helping in the support and comfort of patients; and by volunteers in a programme of biomedical research involving their exposure.

**4.118 Member of public** — Any individual in the population except one who is subject to occupational or medical exposure. For the purpose of verifying compliance with the annual dose limit for public exposure, the member of the public is the representative individual in the relevant critical group.

**4.119 Monitoring** — The measurement of dose or contamination for reasons to the assessment/control of exposure to radiation/radioactive substances and the interpretation of the results.

**4.120 Area Monitoring** — A form of workplace monitoring in which an area is monitored by taking measurements at different points in that area.

**4.121 Environmental Monitoring** — The measurement of external dose rates due to sources in the environment or of radionuclide concentrations in environmental media.

**4.122 Individual monitoring or Personal monitoring** — Monitoring using measurements by equipment worn by individual workers or measurements of quantities of radioactive material in or on their bodies.

**4.123 Workplace monitoring** — Continuous or periodic measurement of radiological or other parameters by using measurements made in the working environment.

**4.124 Personnel monitoring** — A combination of individual monitoring and workplace monitoring

**4.125 Routine monitoring** — Monitoring associated with continuing operations and intended to demonstrate that working conditions, including the levels of individual dose, remain satisfactory; and to meet regulatory requirements. This can be individual monitoring or workplace monitoring.

**4.126 Source monitoring** — The measurement of activity in radioactive material being released to the environment or of external dose rates due to sources within a facility or activity.

## N

**4.127 Natural Uranium** — *see* Uranium

**4.128 NORM** — An acronym for Naturally Occurring Radioactive Material. A radioactive material containing no significant amounts of radio-nuclides other than naturally occurring radio-nuclides.

**4.129 Neutron** — Elementary nuclear particle with a mass approximately the same as that of a hydrogen atom and having no electric charge. Its mass is 1.008 986 mass units.

**4.130 Nuclear Fission** — *see* Fission.

**4.131 Nuclear Reactor** — An assembly in which controlled fission chain reaction can be maintained and controlled. It usually incorporates a fuel, coolant or moderator and other control mechanisms and most often surrounded by a concrete biological shield to absorb neutrons and ionizing radiation.

**4.132 Nucleon** — A constituent of the nucleus, that is, a proton or a neutron.

**4.133 Nucleus** — The core of an atom in which the total positive electrical charge and most of the mass of the atom are concentrated.

**4.134 Nuclide** — A species of atom characterized by its mass number, atomic number and its nuclear energy state, provided the mean life in that state is long enough to be observable.

**4.135 Nuclear Fuel Cycle** — All operations associated with the production of nuclear energy, including mining, milling, processing and enrichment of uranium or processing of thorium, manufacture of nuclear fuel, operation of nuclear reactors, reprocessing of irradiated nuclear fuel, decommissioning and any activity for radioactive waste management and research or development activity related to any of the foregoing.

**4.136 Nuclear Accident** — Any accident involving facilities or activities from which a release of radioactive material occurs or is likely to occur and which has resulted or may result in an international trans-boundary release that could be of radiological safety significance for another state.

**4.137 Nuclear Energy** — The energy released by the nucleus of an atom as the result of nuclear fission, nuclear fusion, or radioactive decay.

**4.138 Occupational Exposure** — All exposures of personnel incurred in the course of their work.

**4.139 Off-site Emergency** — Accident condition/emergency situation involving excessive release of radioactive materials/hazardous chemicals from the plant to the public domain calling for intervention.

**4.140 On-Site Emergency** — *see Plant Emergency*

**4.141 Organ Dose** — The mean absorbed dose in a specified tissue or organ of the human body.

**4.142 Orphan Source** — A radioactive source which is not under regulatory control, either because it has never been under regulatory control or because it has been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization.

**4.143 Overpack** — An additional outer container for one or more waste packages used for handling, transport, storage and/or disposal.

**4.144 Personnel Monitoring** — *see Monitoring*

**4.145 Photon** — A quantum of electromagnetic energy whose energy value (E) in Joules is the product of its frequency ( $\nu$ ) in cycles per second and Planck's constant, h ( $h=6.626 \times 10^{-24}$  J.s). The equation is  $E = h\nu$ .

**4.146 Plant Emergency** — Declared emergency conditions in which the radiological/other consequences, confined to the plant or a section of the plant, requiring immediate operator action.

**4.147 Positron** — A positron is a particle of matter with the same mass as an electron but an opposite charge. It is an antimatter counterpart of electron. When a positron encounters an electron, the two completely annihilate to yield energy in the form of gamma ray photons.

**4.148 Potential Alpha Energy** — The total alpha energy ultimately emitted during the decay of radon progeny or of thoron progeny through the decay chain.

**4.149 Potential Exposure** — Exposure that is not expected to occur with certainty but that may result from an accident at a source or owing to an event or sequence of events of a probabilistic nature, including equipment failures and operating errors. Such events could also include accidents or future events influencing the integrity of a repository.

**4.150 Practice** — Any human activity that introduces additional sources of exposure or additional exposure pathways, or extends exposure to additional people, or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed.

**4.151 Primary Protective Barrier** — Barriers sufficient to reduce the useful X-ray beam to the permissible dose rate.

**4.152 Primary Radiation** — All radiation coming directly from the target of a X-ray tube.

**4.153 Proportional Counter** — Gas filled radiation detection device, in which the pulse produced is proportional to the number of ions formed in gas by the primary ionizing particle.

**4.154 Protection** — The protection of people against exposure to ionizing radiation or radioactive materials and the safety of radiation sources, including the means for achieving this. It also refers to the means for preventing accidents and for mitigating the consequences of accidents should they occur.

**4.155 Protective Action** — An intervention intended to avoid or reduce doses to members of the public in emergencies or situations of chronic exposure.

**4.156 Protective Barriers** — Barriers of radiation absorbing material, such as lead, concrete and plaster that are used to reduce intensity of radiation.



**4.157 Proton** — Elementary nuclear particle with a positive electric charge, equal numerically to the charge of the electron and having a mass of 1.007 594 mass units.

## Q

**4.158 Quantum** — *see* Photon.

## R

**4.159 Rad** — This is the unit of absorbed dose of any ionizing radiation and corresponds to the absorption of 100 ergs/g of the absorbing medium. The roentgen and the rad (in soft tissues) are approximately equivalent in magnitude. SI unit is Gray (Gy)

**4.160 Radiation** — Radiation is a general term for energy which radiates out from a source which can be a part of the Electromagnetic spectrum like Gamma rays, X-rays, or can be rays consisting of alpha particles, beta particles, neutrons, protons termed as ionizing radiation and other nuclear, sub-atomic particles, but not sound or radio waves, or visible, infrared, ultra-violet light.

**4.161 Radiation detriment** — The total harm that would eventually be experienced by an exposed group and its descendants as a result of the group's exposure to radiation from a source.

**4.162 Radiation or Radiological emergency** — *see* Emergency

**4.163 Radiation Hazard** — The risk to health arising from exposure to ionizing radiation. It may be due to external radiation or due to radiation from radioactive materials within the body.

**4.164 Radiation Hygiene** — A term synonymous with radiological health.

**4.165 Radiation Protection** — *see* Protection

**4.166 Radiological Safety Officer (RSO)/Radiation Protection Officer** — A person technically competent in radiation protection matters relevant for a given type of practice who is designated by the registrant or licensee to oversee the application of relevant requirements established in national/international standards.

**4.167 Radiation Sickness** — A self limited syndrome characterized by nausea, vomiting, diarrhea and psychic depression following exposure to appreciable doses of ionizing radiation.

**4.168 Radiation Therapy** — Medical treatment by ionising radiation

**4.169 Radiation Weighting Factor** — Multipliers of absorbed dose used for radiation protection purposes to account for the relative effectiveness of different types of radiation in inducing health effects.

**4.170 Radioactivity** — The phenomenon whereby atoms undergo spontaneous random disintegration, usually accompanied by the emission of radiation.

**4.171 Radioactive Material** — Any substance or material, which spontaneously emits radiation in excess of the levels prescribed by notification by the Central Government.

**4.172 Radioautograph** — *see* Auto Radiograph.

**4.173 Radiological Health** — The art and science of protecting human beings from injury by radiation.

**4.174 Radiation Risks** — The detrimental health effects of exposure to radiation (including the likelihood of such effects occurring). Any other safety related risks (including those to ecosystems in the environment) that might arise as a direct consequence of:

- a) Exposure to radiation;
- b) The presence of radioactive material (including radioactive waste) or its release to the environment; and
- c) A loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation.

**4.175 Radiological Survey** — Evaluation of the radiation hazard incident to the production, use or existence of radioactive materials or other sources of radiation under a specified set of conditions.

**4.176 Radiology** — The medical science of radioactive substances, X-rays and other ionizing radiation and the application of the principles of this science to diagnosis and treatment of disease.

**4.177 Radon Progeny** — The short lived radioactive decay products of Radon-222.

**4.178 Recording Level** — A level of dose, exposure or intake specified by the regulatory body at or above which values of dose, exposure or intake received by workers are to be entered in their individual exposure records.

**4.179 Recovery (Radiology)** — The return towards normal of a particular cell, tissue or organism after radiation injury.

**4.180 Regulatory Body** — A national authority designated by the Government of India having the legal authority for issuing regulatory consent for various activities related to the nuclear and radiation facility and to perform safety and regulatory functions, including their enforcement for the protection of the site personnel, the public and the environment against under radiation hazards.

**4.181 Relative Biological Effectiveness (RBE)** — The ratio of  $\gamma$ -ray or X-ray dose to the dose that is required to produce the same biological effect by the radiation in question.

**4.182 Reprocessing** — A process or operation, the purpose of which is to extract radioactive isotopes from spent fuel for further use.

**4.183 Repository** — A nuclear facility where waste is emplaced for disposal.

**4.184 Risk** — In general terms risk can be defined as the potential for unwanted, adverse consequences to human life, property, health, environment or society. The calculation (or estimation) of risk is usually based on the Probability of the event occurring multiplied by the consequence of the event given that it has occurred. In order to do this a Risk Assessment has to be made which looks at all the hazards, severities and conditional probabilities.

**4.185 Roentgen** — The quantity of X-radiation or gamma-radiation such that the associated corpuscular emission produces 1 electrostatic unit ( $1 \text{esu} = 3.336 \times 10^{-10} \text{C}$ ) of charge of either sign in 0.001 293 g of air (1  $\text{cm}^3$  of air at atmosphere pressure and 0  $^{\circ}\text{C}$ ).

**4.186 Roentgen Equivalent Man (REM)** — That quantity of any type of ionizing radiation, which, when absorbed by man, produces an effect equivalent to the absorption by man of one roentgen of X- radiation or gamma-radiation. This is obtained by multiplying absorbed dose by  $W_R$  and/or  $W_T$ .

**4.187 Roentgenography** — Radiography by means of X-rays.

**4.188 Roentgenology** — That part of radiology which pertains to X-rays.

**4.189 Roentgen Rays** — X-rays.

**4.190 Rotation Therapy** — Radiation therapy during which either the patient is rotated before the source of radiation or the source is revolved around the patient. In this way, a larger dose is built up at the centre of rotation within the body of the patient than on any area of the skin.

**4.191 Routine Monitoring** — *see* Monitoring

## S

**4.192 Scattered Radiation** — Radiation that, during passage through matter, gets deviated in direction. (It may have been modified by a decrease in energy)

**4.193 Scintillation Counter** — The combination of phosphor, photomultiplier tube and associated circuitry for counting light emissions produced in the phosphor by radiation.

**4.194 Sealed source** — Radioactive material that is (a) permanently sealed in a capsule or (b) closely bonded and in a solid form.

**4.195 Secondary Protective Barriers** — Barriers sufficient to reduce stray radiation to the permissible dose rate.

**4.196 Secondary Radiation** — Radiation originating as the result of absorption of other radiation in matter. It may be electromagnetic or particulate in nature.

**4.197 Sievert (Sv)** — The SI unit of equivalent dose and effective dose, equal to 1 J/kg. The equivalent older unit is the Rem where 1 Sv = 100 rem.

**4.198 Somatic Effect** — *see* Health effects of radiation.

**4.199 Source** — Anything that may cause radiation exposure such as by emitting ionizing radiation or by releasing radioactive substances or material – and can be treated as a single entity for protection and safety purposes.

**4.200 Specific Activity** — The activity per unit mass of a radionuclide and normally expressed as Bq/g.

**4.201 Specific Ionization** — Number of ion pairs produced by the ionizing radiation when passing through matter per unit length of the tract of radiation.

**4.202 Stochastic Effect** — *see* Health effects of radiation

**4.203 Stray Radiation** — Radiation not serving any useful purpose. It includes direct radiation and secondary radiation from irradiated objects.

## T

**4.204 Tailings** — The residues resulting from the processing of ore to extract uranium series or thorium series radionuclides, or similar residues from processing ores for other purposes.

**4.205 Teletherapy** — Treatment with external radiation beam(s) where the distance from source to skin is greater than 5 cm.

**4.206 Tissue Weighting Factor** — Multipliers of the equivalent dose to an organ or tissue used for radiation protection purposes to account for the different sensitivities of different organs and tissues to the induction of stochastic effects of radiation.

**4.207 Tracer, Isotopic** — The isotope or non-natural mixture of isotopes of an element which may be incorporated into a sample to make possible observation of the course of that element, above or in combination, through chemical, biological or physical processes. The observations may be made by measurements of radioactivity or by isotopic abundance.

**4.208 Transport Index** — Transport Index (TI) is a number, which, in reality, is the highest radiation level at 1 m from the surface of the package.

## U

**4.209 Uptake** — The processes by which radionuclides enter one part of a biological system from another viz., the body fluids from the respiratory tract, gastrointestinal tract or through the skin, or the fraction of an intake that enters the body fluids by these processes.

## 4.210 Uranium

**4.201.1 Natural Uranium** — Uranium (which may be chemically separated) containing the naturally occurring distribution of uranium isotopes (approximately 99.28 percent uranium-238 and 0.71 percent uranium-235 and 0.005 percent uranium-234 by mass).

**4.202.2 Depleted Uranium** — Uranium containing a lesser mass percentage of uranium-235 than innatural uranium.

**4.202.3 Enriched Uranium** — Uranium containing a greater mass percentage of uranium-235 than 0.72 percent.

**4.202.4 High Enriched Uranium (HEU)**—Uranium containing 20 percent or more of the isotope  $^{235}\text{U}$ .

**4.202.5 Low Enriched Material**— Enriched uranium containing less than 20 % of the isotope  $^{235}\text{U}$ .

## W

**4.203 Waste** — Material for which no further use is foreseen.

**4.203.1 Exempt Waste** — Waste that is released from regulatory control in accordance with exemption principles.

**4.203.2 NORM Waste** — Naturally Occurring Radioactive Material for which no further use is foreseen.

## 4.204 Waste, Radioactive

**4.204.1** Waste that contains, or is contaminated with radionuclides at concentrations or activities greater than clearance levels as established by the regulatory body.

**4.204.2** Exposure to which is not excluded from the Basic Safety Standards.

**4.204.3 Working Level (WL)** — A unit of potential alpha energy concentration (i.e. the potential alpha energy per unit volume of air) resulting from the presence of radon progeny or thoron progeny, equal to  $1.3 \times 10^8 \text{ MeV/m}^3$  (exactly). In SI units, a working level is  $2.1 \times 10^{-5} \text{ J/m}^3$  (approximately).

**4.204.4 Working Level Month (WLM)** — The exposure to radon progeny or thoron progeny which could be incurred during a working month (170 hours) in a constant potential alpha energy concentration of one working level. In S.I units, a working level month is  $3.54 \times 10^{-3} \text{ J.h/m}^3$  (approximately).

## X

**4.204.5 X-Rays** — Electromagnetic radiation resulting from extra nuclear loss of energy of charged particles (namely, electrons) and having shorter wave-length than ultraviolet radiation.

## 5 MEDICAL HAZARDS

### A

**5.1 Acute** — In the medical sense it means of short duration's. As applied to materials inhaled or absorbed through the skin, it refers to a single exposure. As applied to materials ingested, it refers to a single dose.

**5.2 Action Level** — The level of dose rate or activity concentration above which remedial actions or protective actions should be carried out in chronic exposure or emergency exposure.

**5.3 Allergen** — The agent, the presence of which in the body gives rise to allergy.

**5.4 Allergen Potential** — A qualitative term that gives an idea of the allergic action of a material. A substance is said to have a high allergenic potential, if, even very small amounts of that substance give rise to symptoms of allergy.

**5.5 Allergy** — A state in which the cells of the body are hypersensitive to certain substances (allergens), usually

proteins, introduced into it. The reactions of the body exhibit themselves as edema, inflammation and destruction of tissue.

**5.6 Anaesthetic** — A substance which produces insensibility to touch, pain and temperature with or without loss of consciousness.

**5.7 Analgesic** — A chemical, inorganic or organic, which relieves pain.

**5.8 Annual Limit on Intake (ALI)** — The intake by inhalation, ingestion or through the skin of a given radionuclide in a year by the reference man, which would result in a committed dose equal to the relevant dose limit. The ALI is expressed in units of activity.

**5.9 Antibiotic** — A substance produced by micro-organisms which inhibits the growth of or destroys other micro-organisms.

**5.10 Antidote** — A substance given to a patient to counteract the effects produced due to ingestion of a poisonous or toxic chemical or radioactive material.

**5.11 Aplastic Anaemia** — Anaemia not followed by ordinary regeneration of the blood.

**5.12 Asphyxiant** — A substance (gas) exposure to which leads to a morbid condition caused by the failure of the tissues to receive or utilize oxygen, the fault occurring in the lungs, blood or tissues or caused by dilution of atmospheric oxygen.

## B

**5.13 Bone Seeker** — An element which tends to be deposited in the bones of the body because it is either chemically similar to calcium or takes part in bone-forming processes.

## C

**5.14 Cancer** — The common term for malignant neoplasms or tumours. Neoplasias are new growths which occur in some organ or tissue. These can be roughly divided into benign and malignant forms, though in certain cases the distinction is unclear.

**5.15 Carcinogen** — Any agent responsible for causing cancer.

**5.16 Chronic** — In the medical sense, this term is used in contrast to Acute, and means of long duration. As applied to materials inhaled or absorbed through the skin, it means exposure times of long duration. As regards material ingested, it refers to repeated doses.

**5.17 Contaminant** — The substance giving rise to a contamination.

**5.18 Contact Dermatitis** — Inflammation of the surface of the skin or epidermis due to physical contact with an allergy producing material.

## D

**5.19 Dermatositis** — An affliction or inflammation of the deeper parts of the skin.

**5.20 Dosage** — In the medical sense, a measure of any material, expressed in suitable units, that gains entry into the body.

**5.21 Dose** — A measure of the radiation absorbed by a target. The quantities termed absorbed dose, organ dose, equivalent dose, effective dose, committed equivalent dose; or committed effective dose are used, depending on the context. The modifying terms are used when they are not necessary for defining the quantity of interest.

## E

**5.22 Effective Dose** — The quantity E is defined as a summation of the tissue equivalent doses, each multiplied by the appropriate tissue weighting factor:

$$E = \sum_0^T W_T \times H_T$$

where,  $H_T$  is the equivalent dose in tissue T and  $W_T$  is the tissue weighting factor for tissue T.

**5.23 Entrance Surface Dose** — Absorbed dose in the centre of the field at the surface of entry of radiation for a patient undergoing a radio diagnostic examination, expressed in air and with backscatter.

**5.24 Epilation** — The temporary or permanent removal of hair.

**5.25 Equivalent Dose ( $H_{T,R}$ )** The quantity  $H_{T,R}$  is defined as:

$$H_{T,R} = D_{T,R} \times W_R$$

where  $D_{T,R}$  is the absorbed dose delivered by radiation type R averaged over a tissue or organ T and  $W_R$  is the radiation weighing factor for radiation type R. When the radiation field is composed of different radiation types with different values of  $W_R$ , the equivalent dose is:

$$H_{T,R} = \sum W_R \times D_{T,R}$$

**5.26 Erethism** — An abnormal excitement of an organ or tissue. A symptom of mercury poisoning.

**5.27 Erythema** — An abnormal redness of the skin, due to distension of the capillaries with blood. It can be caused by many different agents, such as heat, certain drugs, ultraviolet rays, and ionizing radiation.

**5.28 Extremities** — The hands, forearms and (with restrictions) the head and the feet are considered extremities. The permissible exposure of these areas to radiation is greater, chiefly because they include less blood-forming material and have smaller volumes for energy absorption than other parts of the body.

## F

**5.29 Fertility** — The ability to produce

**5.30 Fibrosis** — The formation of fibrous tissue as a result of injury or inflammation of a part or of interference with its blood supply.

**5.31 Fumigant** — Substance used in the form of vapour and aerosols for destroying microbes and insects.

## G

**5.32 Gene** — One of the factors or determinants responsible for the inheritance of specific character differences between individuals.

**5.33 Genetics** — The branch of biology dealing with the phenomena of heredity and variation.

## H

**5.34 Heredity** — Transmission of characteristic and traits from parent to offspring.

**5.35 Hemolytic Anaemia** — Anaemia accompanied by destruction of red blood corpuscles.

## I

**5.36 Immediately Dangerous to Life and Health (IDLH)** — An IDLH level represents the maximum airborne concentration of a substance to which a healthy person can be exposed for as long as 30 min and still be able to escape without loss of life or irreversible organ system damage.

**5.37 Ingestion** — The act of swallowing materials so that they pass into the body.

**5.38 Inhalation** — As applied to chemical or radiation hazards the act of breathing in or taking into the lungs harmful chemicals, toxic or radioactive, in the form of vapours or fine dust or spray.

**5.39 Irritant** — Any substance that causes local irritation when it comes into contact with the skin or the mucous membranes.

## L

**5.40 Leukocytopenia** — *see* Leukaemia.

**5.41 Lethal Dose** — The quantity of material administered orally or by skin absorption by which 50 percent of the exposed population will be fatally injured.

**5.42 Lesion** — Damage, injury, especially morbid change, in functioning or texture of organs.

**5.43 Lethal Concentration LC50** — A concentration of airborne material by which 50 percent of the exposed population will be fatally injured.

**5.44 Leukaemia** — A disease in which there is a great over production of white blood cells or a relative over production of immature white cells, and great enlargement of the spleen. It is almost always fatal. It can be produced in some animals by long, continued exposures to low intensities of ionizing radiation.

**5.45 Local** — This term refers to the site of action of a poison and means that the action takes place at the point or area of contact. The site may be the skin or the mucous membranes.

## M

**5.46 Maximum Allowable Concentration (MAC)** — The concentration of a poison or toxic substance in air, expressed in suitable units, above which its presence becomes harmful.

**5.47 Maximum Permissible Dose** — The maximum permissible dose for an individual is that dose, accumulated over a long period of time or resulting from a single exposure, which, in the light of present day knowledge carries a negligible probability of severe somatic or genetic injuries. Further more it is such a dose that any effects that ensue more frequently are limited to those of a minor nature that would not be considered unacceptable by the exposed individual and by competent medical authorities.

**5.48 Median Lethal Dose** — *see* LD 50.

**5.49 Mutation** — A change in the characteristics of an organism produced by an alteration of the usual gene pattern.

## N

**5.50 Narcotic** — A substance which produces drowsiness, sleep, unconsciousness, etc., through its effect on the nervous system.

## P

**5.51 Pernicious Anaemia** — Macrocytic anaemia associated with gastro intestinal and neutral disturbance and due to nutritional deficiency based on defects in gastric secretions, marked by pallor, weakness, yellowish colour of the skin, dyspnoea, palpitation and fever.

**5.52 Poison** — Substances, assimilation of which in small quantities, through inhalation, ingestion or absorption results in systemic injury, acute toxic conditions or death within a reasonable time following exposure.

**5.53 Polycythemia** — A disease characterized by over production of red blood cells.

**5.54 Potential Exposure** — Exposure that is not expected to be delivered with certainty but that may result from an accident at a source or owing to an event or sequence of events of a probabilistic nature, including equipment failures and operating errors.

## R

**5.55 Relative Biological Effectiveness (RBE)** — The ratio of  $\gamma$ -ray or X-ray dose to the dose that is required to produce the same biological effect by the radiation in question.

## S

**5.56 Sarcoma** — *see* Cancer.

**5.57 Sedative** — A drug possessing the property of producing soothing effect.

**5.58 Sigmoid Curve** — S-shaped curve often characteristic of a dose-effect curve in radio-biological studies.

**5.59 Skin Dose (Radiology)** — Dose at centre of radiation field on skin. It is the sum of the aim dose and that due to the back scattered radiation.

**5.60 Soporific** — A substance that causes sleep or drowsiness.

**5.61 Sterility (Biological)** — Temporary or permanent incapability to reproduce.

**5.62 Stimulant** — A substance that temporarily quickens some vital process or the function of an organ.

**5.63 Stochastic Effects of Radiation** — Radiation effects generally occurring without a threshold level of dose whose probability is proportional to the dose and whose severity is independent of the dose.

**5.64 Systemic** — Effect of a poison at a site of action other than the point of application. This presupposes that absorption has taken place.

**5.65 Symptom** — Evidence of a disease or disorder as experienced by a patient.

**5.66 Syndrome** — A concurrence of several symptoms or signs in a disease which are characteristic of it.

## T

**5.67 Tumor** — Generally refers to abnormal tissue growth in the body, often associated with swelling.

**5.68 Threshold Dose** — The minimum dose that will produce a detectable degree of any given effect.

**5.69 Threshold Limit Value** — The concentration of a contaminant or toxic substance in air at which, on the basis of present day knowledge, workers may be repeatedly exposed without any perceptible adverse

effect on their health during the life time. This value should be used as a guide in the control of health hazards and should not be regarded as a fine line between safe and dangerous concentrations.

**5.70 Tissue Dose** — Dose received by a tissue in the region of interest, In the case X-rays and  $\gamma$ -rays, tissue doses are expressed in roentgens.

**5.71 Tolerance Dose** — The amount of radiation which may be received with expectation of no significantly harmful result. A more acceptable term is Maximum Permissible Dose.

**5.72 Toxicity** — The poisonous nature of a substance (*see also* Poison).

**5.73 Toxicology** — That branch of science which deals with the nature and effect of poisons.

## 6 EXPLOSIVE HAZARDS

### A

**6.1 Abel Heat Test** — British official heat test which is generally applied to nitro-explosives. The principle of the test is to note the time required to produce a standard tint on a potassium iodide-starch paper when the explosive is heated under specified conditions.

**6.2 Ammunition** — Explosive substances when enclosed in any case or contrivance or otherwise adopted or prepared so as to form a cartridge or charge for small arms, guns, rockets or other weapons and components thereof such as caps, detonators, primers, boosters, fuses, shells, warheads, etc.

**6.3 ANFO** — an explosive material consisting of Ammonium Nitrate and Fuel Oil.

## B

**6.4 Ballistic Pendulum** — An apparatus for measuring the relative power of different explosives as compared to a standard explosive by determining the weights of different explosives, which when fired will produce similar deflection of the pendulum.

**6.5 Ballistics** — The branch of applied physics which deals with the motion of projectiles and the conditions governing that motion, commonly called the science of shooting.

**6.6 Binary Explosives** — Mixtures of TNT with another explosive, such as RDX, PETN or with another explosive and a non-explosive material such as ammonium nitrate and aluminium powder.

**6.7 Black Powder** — A low explosive consisting of a mixture of sulfur, charcoal, and an alkali nitrate, usually potassium or sodium nitrate.

**6.8 Blasting Agent** — An explosive material which meets prescribed criteria for insensitivity to initiation.

**6.9 Blasting Fuse** — A device consisting of a length of slow burning composition which delays the firing of an explosive charge sufficiently to allow the person firing it to get out of danger.

**6.10 Booster** — An intermediate high explosive charge in an Explosive Train, which is easily initiated by the primary charge and detonates at high speed, thereby imparting sufficient impulse to the main explosive charge to detonate completely.

**6.11 Brisance** — Used for shattering power of an explosive as distinguished from its total work capacity and indicates its ability to shatter and fragment steel, concrete and other very hard structures and is dependent upon its velocity of detonation.

## C

**6.12 Camouflaged device** — An explosive device disguised to avoid detection.

**6.13 Cap** — The part of a cartridge or shell which is filled with a detonative composition and is fired by a percussion strike. It ignites the propellant charge in gun and small arm ammunition.

**6.14 Cleveland Open Cup Method** — A method for determining the flash point of a liquid. In this the vapour being experimented upon has free access to air and thus is slightly less concentrated than the one in the Closed Cup Method (*see also* Closed Cup Method).

**6.15 Closed Cup Method** — One of the methods for determining the flash point of a liquid. In this method, measurements are made on a saturated vapour air mixture obtained in a closed cup.

**6.16 Collective Dose** — An expression for the total radiation dose incurred by a population and defined as the product of the number of individuals exposed to a source and their average radiation dose.

**6.17 Combustible** — Any material capable of combustion.

**6.18 Combustion** — The action or the process of burning, usually associated with the development of light, heat and chemical combination.

**6.19 Commercial Explosives** — explosives designed, produced, and used for commercial or industrial applications.

**6.20 Consequence Management** — Response to a disaster focused on alleviating damage, loss, hardship, or suffering.

## D

**6.21 Deflagration** — A release of energy caused by the propagation of a chemical reaction in which thereaction front advances into the unreacted substance at less than sonic velocity in the unreacted material. Where a blast wave is produced that has the potential to cause damage, the term explosive deflagration may be used.

**6.22 Detacord®** — A brand name for a detonating cord manufactured by Ensign Bickford Company.

**6.23 Detonating Cord** — A flexible cord containing a center core of high explosives used to detonate other explosives. The exterior has a waxy appearance and is initiated by means of a blasting cap. Colors and material of detonating cord are variable, according to each manufacturer.

**6.24 Detonation** — An explosive reaction that moves through an explosive material at a velocity greater than the speed of sound in the material.

**6.25 Detonator** — Any device containing an initiating or primary explosive that is used for initiating detonation. A detonator is not permitted to contain more than 10 grams of total explosive material per unit, excluding ignition or delay charges. The term includes, but is not limited to, electric detonators of the instantaneous and delay types, detonators for use with safety fuses, detonating cord delay connectors, and nonelectric detonators of the instantaneous and delay types that consist of a detonating cord, a shock tube, or any other replacement for electric leg wires. Unless specifically classified otherwise, detonators are

classified 1.1 (Class A explosives). Also *see* Detonators 1.4 (Class C explosives).

**6.26 Dirty Bomb** — A conventional explosive that is packaged with radioactive material that scatters when the bomb is detonated.

**6.27 Dynamite** — A high explosive used for blasting, consisting essentially of a mixture of, but not limited to, nitroglycerin, nitrocellulose, ammonium nitrate, sodium nitrate, and carbonaceous materials.

**6.28 Electric Detonator** — A detonator designed for, and capable of, initiation by means of an electric current.

**6.29 Electron Volt (eV)** — A unit of energy equivalent to the amount gained by an electron in passing through a potential difference of one volt. Large multiple units of the electron volt are frequently used, such as KeV for kilo electron volts (1 000 eV), MeV for million electron volts (10<sup>6</sup> eV), and BeV for billion electron volts (10<sup>9</sup> eV).

**6.30 Episodic Event** — An event (typically incident) of limited duration; e.g., release of hazardous materials, spill, explosion.

**6.31 Esop Test** — A test in which an explosive, such as picric acid, is mixed with olive oil or cotton seed oil and trials are made in order to determine the highest proportion of oil which may be present without causing failure to detonate by the initiating explosive present.

**6.32 Explosion** — a chemical reaction involving an extremely rapid expansion of gases, usually associated with the liberation of heat.

**6.33 Explosive** — Substance, which under certain conditions of temperature, shock or chemical action can decompose rapidly to evolve either large volumes of gases or so much heat that the surrounding air is forced to expand very rapidly.

**6.34 Explosive Materials** — These include explosives, blasting agents, and detonators. This term includes, but is not limited to, dynamite and other high explosives; slurries, emulsions and water gels; black powder and pellet powder; initiating explosives; detonators (blasting caps); safety fuse; detonating cord; igniter cord; and igniters.

**6.35 Explosive Range** — This is the range of concentration over which a particular vapour or gas will be conducive for propagation of flames (*see also* 'Flammability Limits').

**6.36 Explosive Train** — Series of explosive substances arranged according to decreasing sensitivity and increasing power or brisance so as to enable a small impulse from an initiator explosive develops into a sufficient powerful impulse through the medium of intermediate explosives which will be sufficient to cause detonation of the main explosive filling or explosive charge.

**6.37 Explosives, Classification of** — Explosives may be classified into three distinct classes of materials according to their functioning characteristics, such as:

**6.37.1 Primary Explosives or Initiatory Explosives** are those which explode or detonate on application of small external energy produced by friction, sudden impact, or heat, for example, mercury fulminate lead azide, lead styphanate, etc.

**6.37.2 Low Explosives or Propellants** are those which undergo auto-combustion at rates that may vary from a few centimetres per minute to 400 m/sec. Examples of these are gunpowder, NC powders and colloidal propellants containing nitrocellulose and nitroglycerine with or without other ingredients.

**6.37.3 High Explosives** — These explosives are comparatively less sensitive than primary explosives but when suitably initiated, undergo very rapid, almost instantaneous, decomposition, with velocity of detonation which may vary from 1 000 m/sec to 8 500 m/sec. Common example of these are TNT, cyclonites, dynamites, etc.

## F

**6.38 Fireworks** — Combustible or explosive compositions or manufactured articles designed and prepared for the purpose of producing audible or visible effects.

**6.39 Flammability Limit** — A flame can propagate in a mixture of combustible gas and air (or oxygen) only if the concentration of the gas is between two limits known as the lower and upper flammable (exposure) limits.

**6.40 Flare** — A pyrotechnic device designed to produce a single source of intense light.

**6.41 Flash Point** — The lowest temperature of a liquid at which a flame can be propagated across the surface of the liquid when a standard ignition source is applied.

**6.42 Flashless Powders** — Explosive substances which give no visible flash in daylight and only a red glow at night. The flashlessness is effected by reducing the explosion temperature by the addition of DNT, powdered metal, metallic salt, etc.



**6.43 Fuse**

**6.43.1** A tube, casing or cord, etc, filled with combustible material or explosive material by means of which an explosive charge is initiated.

**6.43.2** A mechanical device containing primary explosives with or without booster explosive charge designed to function a projectile, a bomb or a mine at a predetermined time and place.

**G**

**6.44 Gaine** — A device used for converting the flash produced by an igniferous fuze into a detonation wave required to accomplish complete detonation of the high explosive charge in a shell.

**H**

**6.45 High Explosives** — Explosive materials that can be caused to detonate by means of a blasting cap. A few examples of high explosives would be boosters, detonators, dynamite, water gels/slurries, and emulsions.

**6.46 HME** — Home Made Explosives; a combination of commercially available ingredients combined to create an explosive substance.

**I**

**6.47 Igniter** — A device filled with combustible or explosive material used for igniting safety fuse or initiating an explosive charge.

**6.48 Ignition** — The initiation of an explosive or flammable mixture of gases, vapours or other substances.

**6.49 Immediately Dangerous to Life and Health (IDLH)** — An IDLH level represents the maximum airborne concentration of a substance to which a healthy person can be exposed for as long as 30 minutes and still be able to escape without loss of life or irreversible organ system damage.

**6.50 Improvised Explosive Device** — A delivery system to deliver an explosive charge using items or methods not initially designed for this purpose.

**6.51 Initiating Explosive** — Compounds that are sufficiently sensitive to friction, heat or impact, to undergo detonation or combustion under such physical causes. These possess more or less capacity to transmit a detonation wave to less sensitive explosives.

**6.52 Intermediaries** — High explosives used to pick up the small but concentrated shock given by the initiator and transform it into a violent impulse to detonate the shell filling. Their sensitiveness lies between that of the initiators and of bursting charges.

**L**

**6.53 Lower Explosive Limit (LEL)** — The minimum percent by volume of flammable vapour in air below which flame will not propagate in the mixture. *see also* 'Explosive Range' and 'Flammability Limit'.

**M**

**6.54 Military Explosives** — Items of equipment designed primarily for military offensive or defensive operations. A few examples of military explosives are M6 military electric detonators, M112 demolition charge, C4, TNT, and TOW blast simulators.

**6.55 Mortar Test** — A test employed for measuring relative power of an explosive in comparison with a standard explosive.

**N**

**6.56 Nitrating Mixture** — Mixture of nitric acid and sulphuric acid with or without varying amounts of water, used in the manufacture of explosives by nitration process.

**6.57 Nitroglycerin** — An explosive chemical compound that is used as a sensitizer in dynamite.

**O**

**6.58 Oxidizer or Oxidizing Material** — A substance, such as nitrate, that readily yields oxygen or other oxidizing substances to stimulate the combustion of organic matter or other fuel.

**P**

**6.59 PBIED** — An IED worn by a person, such as a vest, belt, backpack, etc., in which the person houses the whole IED or principle IED components and/or serves as the delivery or concealment means for explosives with an initiating device.

**6.60 Percussion** — Initiation of primary explosive charge by impact striking to produce a spark or an initial impulse to explode an explosive charge.

**6.61 Permissible Explosives** — Explosives permitted to be used in gassy mines.

**6.62 Primer** — A device containing explosives used to ignite a secondary explosive, etc.

**6.63 Propellant** — A low explosive in which the rate of energy release by auto-combustion can be controlled within limit (which may vary from a few centimetres per minute to 400 metres per second) and which will thus produce moderately high and sustained gas pressure for imparting acceleration to the projectile or the missile.

**6.64 Pyrotechnics** — Any combustible or explosive compositions or manufactured articles designed and prepared for the purpose of producing audible or visible effects.

## S

**6.65 Safety Fuse** — It consists of a train of slow burning gunpowder enclosed in waterproof covering and used for initiation of a detonator or an explosive charge from a safe distance.

**6.66 Secondary Device** — An explosive device set to detonate after arrival of first responders. The purpose of the device is to injure emergency responders.

**6.67 Shock Wave** — A compression wave caused by sudden rise of pressure due to release of large quantity of gaseous products at high temperature resulting from decomposition of the explosive material.

**6.68 Small Arms Ammunition Primers** — Small percussion-sensitive explosive charges encased in a cap or capsule and used to ignite propellant powder.

**6.69 Smokeless Propellant (Smokeless Powder)** — Solid propellant, commonly called smokeless powder in the trade, used in small-arms ammunition, cannons, rockets, propellant-actuated powder devices, etc.

**6.70 Spontaneous Ignition** — Many substances combine with atmospheric oxygen at ordinary temperature and liberate heat. If the heat is liberated faster than it is dissipated, a fire can start. This process is called spontaneous ignition.

**6.71 Stabilizer** — Substances, such as diphenylamine centralities which are added to explosives, such as nitrocellulose and nitroglycerine to prevent them from gradual decomposition due to storage. These additives neutralize the nitric acid produced thus preventing enhanced degradation rates.

**6.72 Susceptibility to Spontaneous Ignition (SSI)** — The tendency to undergo spontaneous ignition (*see* Spontaneous Ignition).

**6.73 Sympathetic Detonation** — Detonation caused by transmission of a high energy shock wave through air emanating from one explosive charge to another explosive charge at some distance resulting in the detonation of the latter.

## T

**6.74 Trauzl Lead Block Test** — A test based on the volume of the cavity produced when a given weight of an explosive is fired in a bore-hole in a lead block of specific dimensions.

## V

**6.75 VBIED** — An IED delivered by any small ground-based vehicle (e.g. passenger vehicle, motorcycle, moped, bicycle, etc.) and/or serves as the concealment means for explosives with an initiating device.

**6.76 Velocity of Detonation** — The speed at which detonation travels through the mass of the explosive and depends upon a number of factors such as density, degree of confinement and temperature.

**ANNEX A**  
(Foreword)

**COMMITTEE COMPOSITION**  
Chemical Hazards Sectional Committee, CHD 07

<i>Organization</i>	<i>Representative(s)</i>
In Personal Capacity	SHRI K. S. RAMPRASAD ( <i>Chairperson</i> )
Alkali Manufacturers Association of India, Mumbai	SHRI K. SRINIVASAN SHRI H. S. DAS ( <i>Alternate</i> )
Bhabha Atomic Research Centre, Mumbai	MS GARIMA SINGH SHRI NISHITH GOSH ( <i>Alternate</i> )
Central Leather Research Institute, Chennai	DR M. SURIYANARAYANAN
Centre for Fire, Explosives and Environmental Science, GoI, Min Of Def	SHRI S. P. DOBHAL DR AARTI BHATT ( <i>Alternate</i> )
Central Food Technological Research Institute, Mysore	DR DANDAMUDI USHARANI DR PRASANNA VASU ( <i>Alternate</i> )
Crop Care Federation of India , New Delhi	MR P. N. KARLEKAR DR J. C. MAJUMDAR ( <i>Alternate</i> )
Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, GoI	DR VISHAL CHOUDHARY
Department of Space(ISRO), Bengaluru	SHRI MURALEEKRISHNAN R. MS LAKSHMI V. W. ( <i>Alternate</i> )
Directorate General Factory Advice Service and Labour Institutes , Mumbai	SHRI H. M BHANDARI SHRI P. G. SATPUTE ( <i>Alternate</i> )
Defence Research and Establishment, (DRDO), Gwalior	DR PRABHAT GARG DR VIRENDRA VIKRAM SINGH ( <i>Alternate</i> )
Hindustan Unilever Limited , Mumbai	SHRI SANJAY HARLAKA SHRI RAKESH WADALKAR ( <i>Alternate</i> )
Gas Industries Association	SHRI SUNIL KHER SHRI ANOOP TANDON ( <i>Alternate</i> )
Indian Chemical Council , Mumbai	DR C. NANDI DR RAKESH KUMAR ( <i>Alternate</i> )
Indira Gandhi Centre for Atomic Research, Kalpakkam	DR K. K. SATPATHY
Indian Institute of Chemical Technology, Hyderabad	DR BANKUPALLI SATYAVATHI DR SRIPADI PRABHAKARC ( <i>Alternate</i> )
Indian Institute of Petroleum , Dehradun	DR NEERAJ ATRAY DR PANKAJ KUMAR KANUJIA ( <i>Alternate</i> )
Indian Institute of Technology, Mumbai	PROF SANDIP ROY
Indian Institute of Technology, Chennai	DR SACHIN GUNTE

Indian Institute of Toxicology Research, Lucknow	DR D. K. PATEL DR SHEELENDRA PRATAP SINGH ( <i>Alternate</i> )
Institute of Chemical Technology, Mumbai	PROF (DR) G. D. YADAV DR B. M. BHANAGE ( <i>Alternate</i> )
Ministry of Environment and Forest , New Delhi	SHRI VED PRAKASH MISHRA DR DINESH RUNIWAL ( <i>Alternate</i> )
National Chemical Laboratory, Pune	DR VIJAY V. BOKADE DR M. MUTHUKRISHNAN ( <i>Alternate</i> )
National Institute of Occupational Health, Ahmedabad	DR B. RAVICHANDRAN
National Institute of Technology, Thrichi	PROF S. P. SIVAPIRAKASAM D SREEJITH MOHAN ( <i>Alternate</i> )
National Safety Council , Navi Mumbai	SHRI A. Y. SUNDKAR SHRI K. D. PATIL ( <i>Alternate</i> )
Oil Industry Safety Directorate (Min of Pet and Natural Gas), Delhi	SHRI DEVENDAR M MAHAJAN
Pesticides Manufacturer and Formulators Association of India	DR ARCHANA KUMARI DR SANDIP SINGH ( <i>Alternate</i> )
Petroleum and Explosives Safety Organisation, Nagpur	SHRI M. K. JHALA DR YOGESH KHARE ( <i>Alternate</i> )
Safety Appliances Manufacturers Association, Mumbai	SHRI MOHAMMAD SHRI DEVANG MEHTA ( <i>Alternate</i> )
Shriram Institute for Industrial Research, Delhi	DR JAGDISH KUMAR DR DEEP SHANKAR CHATTERJEE ( <i>Alternate</i> )
Tata Chemicals Ltd, Mithapur, Distt, Jamnagar	SHRI SNEHASHISH A. CHAKRABORTY SHRI D. K. THAKUR ( <i>Alternate</i> )
In personal capacity ( <i>I-4/2/6, Parijat C.H.S., Spaghetti, Sector-15, Kharghar, Navi Mumbai, 410210</i> )	SHRI S. SOUNDARARAJAN
BIS Directorate General	SHRI AJAY K. LAL, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (CHEMICAL DEPARTMENT) [REPRESENTING DIRECTOR GENERAL ( <i>Ex-officio</i> )]

*Member Secretary*  
MS SHUBHANJALI UMRAO  
SCIENTIST 'B'/ASSISTANT DIRECTOR  
(CHEMICAL DEPARTMENT ), BIS



## Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 2016* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

### Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Head (Publication & Sales), BIS.

### Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website- [www.bis.gov.in](http://www.bis.gov.in) or [www.standardsbis.in](http://www.standardsbis.in).

This Indian Standard has been developed from Doc No.: CHD 07 (17326).

### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

## BUREAU OF INDIAN STANDARDS

### Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones: 2323 0131, 2323 3375, 2323 9402

Website: [www.bis.gov.in](http://www.bis.gov.in)

### Regional Offices:

	Telephones
Central : 601/A, Konnectus Tower -1, 6 <sup>th</sup> Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	{ 2323 7617
Eastern : 8 <sup>th</sup> Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	{ 2367 0012 2320 9474
Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	{ 265 9930
Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	{ 2254 1442 2254 1216
Western : Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	{ 2821 8093

**Branches :** AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.